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ABSTRACT

This volume includes reports of five research projects of the Kansas Center for Research in Early Childhood Education: (1) Individual Differences in Newborn and Young Infants, including research with the Brazelton Neonatal Assessment Scale and laboratory studies of infant discriminative abilities; (2) Development of Social Competence, including reports on the use of videotape apparatus in time-coding of social interaction, a code for temporal analysis of mother-infant interaction, and computer analysis of time-coded mother-infant interaction; (3) Attention and Cognitive Styles, including a users' manual and a technical report on the Kansas Reflection-Impulsivity Scale for Preschoolers (KRISP) as well as two studies of attending behavior in young children; (4) Development of Generative Language in Retarded Children, including a study of the effects of contingent modeling on usage of passive voice by normal preschoolers; and (5) Infant Day Care Research, reporting on across-environment evaluation and data gathering procedures. (BF)

UNIVERSITY OF KANSAS

KANSAS CENTER FOR RESEARCH

IN EARLY CHILDHOOD EDUCATION

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FY 1972

Annual Report

THE KANSAS CENTER
FOR RESEARCH IN EARLY CHILDHOOD EDUCATION

Department of Human Development

University of Kansas

John C. Wright

Director

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NOTE:

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INTRODUCTION

The Kansas Center for Research in Early Childhood Education has, since 1969, been conducting basic and applied research on the development of cognitive and social competence in young children from birth to approximately nine years of age. It has also focussed on the development of techniques and systems of general efficacy for promoting competencies directly related to subsequent performance in school learning situations. Until March 1, 1973, the Kansas Center will continue to be a component in the National Program in Early Childhood Education (NPECE). NPECE has been administered in recent years by the Central Midwestern Regional Educational Laboratory (CEMREL) with funds from the U. S. Office of Education.

In July, 1972, U. S. O. E. was replaced by the National Institute of Education (N. I. E.) as the source of federal funding, and the "Center" concept began to be phased out, to be replaced by a "program" funding concept for future N. I. E. operations. Concurrently five of the eight programs of the Kansas Center were placed in phase-out status. Of these five programs, one, "The experimental analysis of preschool teachers' behaviors," directed by Professors Holmberg, Thompson, and Baer, completed its funding period in August, and submitted its final report on October 1, 1972. The remaining four programs in phase-out status have made their final reports in this Annual Report. They are programs directed by Professors Rosenfeld, Sherman, Etzel, and Wolf.

Funding will continue for three programs, those directed by Professors Horowitz, Wright, and Risley, through CEMREL until March 1, 1973, and directly from N. I. E. from then until 30 November, 1973. Thereafter they will apply for funding by N. I. E. as contracted programs, and <u>not</u> as components of the Kansas Center or of NPECE.

In this two-volume report are sections covering seven research programs in the Kansas Center, and containing a total of 21 reports. Many of these reports will be published separately in the form of journal articles or presented at scientific conventions and conferences. Some also provide the basis for theses and dissertations of graduate students in the Department of Human Development. We would again like to emphasize that one of the most significant categories of "products" of the Kansas Center has been the research professionals who have received graduate, and often undergraduate training within its programs.

There remains the pleasant duty of trying to acknowledge the large number of individuals whose cooperation and assistance have made our work possible. Throughout its history the Kansas Center has enjoyed the full support of the University and the Department in which it is housed. Deans William Argersinger, Henry Snyder, and Barbara Etzel have always been most helpful, and Frances Horowitz, Chairperson of the Department of Human Development has been a mainstay. The staff at CEMREL, including Wade Robinson, Tom Johnson, Merilee Lovett, and especially Winnie Kleinnecht have seen us through some difficult times with skill and patience. Perhaps our greatest debt is to our own staff, and in particular to Ann Branden, our Administrative Research Assistant, whose skill, dedication, and charm have made the whole enterprise possible.

John C. Wright
Director

FY 1972

December, 1972

Project:	Individual Differences in Newborn and Young Infants
Project Code No.:	IHOK04
Principal Investigator:	Frances Degen Horowitz
Contents of this report:	K04-2 Progress Report

KANSAS CENTER FOR RESEARCH IN EARLY CHILDHOOD EDUCATION

Project No. IIHOK04-2

INDIVIDUAL DIFFERENCES AND DISCRIMINATIVE ABILITIES IN NEWBORN AND YOUNG INFANTS

Progress Report

December, 1972

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Introduction

Though this progress report is concerned specifically with our work of the last six months, a full understanding of the research to be reported here will benefit from a brief review of the background of the research over the last several years. Ever since the early reports by Fantz (1958) and Berlyne (1958) that infant visual behavior could be reliably studied, research in infant visual behavior has mushroomed. It would appear that the ability to visually attend to stimuli is already well developed in the newborn. Further, it has been reported that with repeated presentation of the same stimulus the newborn infant will sometimes habituate his/her attending behavior (Friedman, 1972). Thus, while the response of visual attending undoubtedly undergoes changes during the course of early development, it is not only well developed but appears to be under some stimulus control in the very young infant. Among the earliest findings to be reported were those by Brennan, Ames, and Moore (1966) who indicated that they had demonstrated differential attending to stimuli of different complexity levels: Younger infants (3 weeks of age) looked more at simpler checkerboard sitmuli, while 8 week old infants looked at intermediately complex stimuli the longest and the oldest infants in their sample (14 weeks) looked at the most complex checkerboards the longest. It was this finding that prompted the earliest work of the Kansas Infant Research Laboratory. As has now been reported, we failed to replicate this finding in three different studies (Horowitz, 1969; Horowitz, Paden, Bhana, Aitchinson, & Self, 1972; Horowitz, Paden, Bhana, & Self, 1972).

The studies reported above were begun just prior to joining the National Program in Early Childhood Education. In the process of conducting our original research we noted that the use of the standard procedure of presenting stimuli for fixed periods of twenty or thirty seconds often resulted in off-setting the stimulus while the infant was still fixating it. This led to the development of an "infant control" procedure that left the stimulus on for as long as the infant was looking at it. When the infant ceased fixating for two consecutive seconds the stimulus was offset and another stimulus presented. As has been reported (Horowitz, et. al., 1972b) the results were encouraging with regard to a drastic reduction in subject loss and the observation of an enormously expanded sample of infant behavior. All of our subsequent research has utilized this basic procedure with some modifications.

Methodological background: The modifications of the original infant control procedure have been made in the interest of studying infant attention and discrimination within an habituation paradigm. Habituation is a well known phenomenon that involves the repeated presentation of a single stimulus and then the subsequent introduction of a different stimulus in the same stimulus modality. Typically, attending behavior declines over the repeated presentations. If attending behavior increases with the new stimulus, stimulus discrimination is inferred because control subjects who get no new stimulus at the change point but continue to receive the old stimulus typically show no increase in attending behavior. Two studies conducted in our laboratory were concerned with using the infant control procedure to study infant visual discrimination within the habituation paradigm.

We studied discrimination in eleven and twelve week old infants using two very different stimuli of a picture of a child vs. a checkerboard stimulus and two more similar stimuli of a square vs. a circle (Bhana, 1970). In this study we introduced the second stimulus (B) only after the infant had given three consecutive looks of less than ten seconds each to the first stimulus (A). While we were able to demonstrate discrimination of the two different stimuli (and to some extent of the two similar stimuli), it was clear that there were several problems in our procedure: Infants who began as very long lookers took a very long time to meet the three consecutive looks of ten seconds or less criterion to Stimulus A; we had a relatively high number of infants fall asleep in the procedure; the standard criterion for all infants seemed in direct opposition to the individual approach of the infant control procedure. Thus, in the next study we attempted to see if an individually fashioned criterion for response decrement could be used such that Stimulus B would be introduced when the infant had given two consecutive looks that were each less than half of the first look to Stimulus A (Laub, 1972). And, in this study we also attempted to determine what would happen if we had the control subjects continue with Stimulus A past the change point. The stimuli were the picture of a little girl and a checkerboard square. The results were encouraging: The individually fashioned criterion for response decrement resulted in very few cases of infants falling asleep during the procedure; control subjects rarely showed an increase in fixation after criterion had been met; the demonstration of discrimination was much clearer than in the previous study. In examining the results of this study two things were obvious: At the first presentation of Stimulus B, after the repeated presentation of Stimulus A, the fixation was often very short the long (discriminating) fixation occurred on the second presentation of Stimulus B. It was as if the subject was not expecting a different stimulus the first time it was presented. Subjects in the infant control procedure often adopt "turn-off" strategies of looking away quickly after repeated presentations of the same stimulus, as if they have learned that the look-away will off-set the stimulus. Thus, the first time the new stimulus (Stimulus B) is presented the infant often exhibits the quick look, quick non-look behavior almost before he/she can register the fact that the stimulus is new. Quite often these very short looks at the first presentation of the new stimulus were followed by long looks at the second presentation. In studies that use an A-B-A-B repeated design of habituation, dishabituation, habituation and then dishabituation again the second, third, and fourth parts of the A-B-A-B design are very susceptible to this problem. In inspecting our data it became clear that an habituation criterion that utilized the mean of the first two fixations to the new stimulus would be better. Thus, in most of our subsequent studies, and in the studies that are the especial subject of this report the criterion used for response decrement involves two consecutive looks that are at least half the mean of the first two fixations to that particular stimulus.

Substantive background: While the above dwells upon procedural aspects our main concern has been with the substantive issues of infant discrimination, individual differences and attending behavior. Like many others who are working to understand the degree to which young infants can and do process stimulus information we have been interested in individual differences and how they might determine the functionality of environmental stimulation.

Our research has dealt with two major problem areas: The assessment of the newborn infant and the laboratory analysis of infant discriminative abilities. Relating to both of these issues has been our concern for understanding how the infant uses environmental stimulation or information. Modern infant research has been revealing that the infant is a competent organism in the processing of environmental stimulation, that he/she can make discriminations we did not realize were possible and that the individual infant brings to the environment a broad set of individual characteristics. But, we do not know how stable these characteristics are, how early they may be detected or in just what way they affect the interactive process of organism and environment. It has been our goal to add to the basic knowledge that would enhance these understandings. Thus, early in our involvement in the National Program we began collaborating with Daniel Freedman of Chicago University who was working with Dr. T. Berry Brazelton a Cambridge, Massachusetts pediatrician who was associated with Harvard University. Brazelton had developed a newborn infant assessment technique that went beyond the usual motoric and reflex items. It included a range of items aimed at assessing the social and non-social responsiveness of the infant to auditory, visual, tactile and kinesthetic stimulation. Our initial study using the Scale helped to establish its reliability and validity (Self, 1971; Horowitz, Self, Paden, Culp, Laub, Boyd, and Mann, 1971). Subsequent revision of the Scale has brought it to its final form and we have recently been engaged in using the final form in a major study attempting to track the early development of a sample of 49 infants described below.

We have been able to demonstrate the utility of the Scale for identifying individual differences in laboratory behavior. A sample of 60 infants were tested at three days of age and then again at one month of age. At five and six weeks of age these same infants visited the laboratory and were shown a series of checkerboard slides repeatedly (Self, 1971). Following response decrement the slides were not changed but music was added to the environment. Most of the infants showed an increase in attending to the slides. However, one group of infants did not show any increase. A review of performance on the Brazelton Scale earlier revealed that those infants showed no increase in looking when music was added had scored significantly lower on items of auditory responsiveness than infants for who the addition of music was related to an increase in visual attending behavior. Thus, the functional relationship between visual attention and auditory stimulation was dependent, in part, upon individual characteristics.

We have also observed that the results of our laboratory experimental analyses show marked uniformity between individual subject data and group data, in sharp contrast to the findings of many infant researchers who report extreme variability of effects for individual subjects. We attribute this primarily to our use of the infant control procedure that allows the individual infant to attend at his own rate and uses an individually fashioned criterion for stimulus change. In effect, what we are suggesting is that if you use a standard criterion for all infants the results will show much greater variability in whether or not an individual infant shows the effect of an experimental manipulation than if the individual characteristics of the infant are allowed to be part of the experimental procedure. The result is that failures to show a strong experimental effect may be the result of that effect being masked by the "noise" introduced by the arbitrary experimental procedures.

Following our demonstration that the addition of an auditory stimulus could re-recruit infant visual attending behavior even though the visual stimulus had not changed we were able to ask several questions: 1) Whether the human voice could act in a similar way to music; 2) Whether it was just stimulus change per se that was responsible for the increased attending or whether it was the <u>addition</u> of stimulation; 3) What kinds of auditory discriminations could we demonstrate using visual attention as the response. Thus, the laboratory component of our work has revolved around auditory and visual discrimination in infants from eight weeks of age and on.

The studies to be reported in detail below are divided into two sections. The first concerns the research with the Brazelton Neonatal Scale and the second concerns the experimental laboratory studies.

Neonatal Assessment

<u>Subjects</u>: 49 newborn infants, 20 male, 29 female primarily caucasian ranging from the upper lower to upper middle class.

<u>Procedure</u>: Subjects were tested with the Brazelton Neonatal Assessment Scale on Days 1, 2, 3, 4, 5, 7, 10, and at one month of age. A pool of trained testers from the project staff were rotated so that, where possible, no tester tested an infant on two consecutive days. All testers were blind with regard to the history of the infant, with especial concern for the kind of medication the mother might have had during labor and delivery. There was no discussion of any infant among the staff and score sheets were immediately filed so that no one else saw the scores from any particular day except the tester.

After all the data had been collected the hospital records of the mothers were reviewed and the amount, kind, and timing of all drug administrations during labor and delivery were recorded.

Results: For the first analysis the drugs given the mother during labor and delivery were recorded and five groups of infants were derived:

N=5	Group 0	Nothing during labor or delivery
N=20	Group I	Received one of the following: 30 mg. or less of Nisentil, 25 mg. or less of Sparine, or 50 mg. or less of Demerol in eight hours preceding delivery.
N=7	Group II	Received 30-60 mg. of Nisentil, 25-50 mg. of Sparine, 60-100 mg. of Seconal or 100 mg. Demerol in eight hours prior to delivery.
N=4	Group III	Received two or more of the above in doses of 60 mg. Nisentil, 50 mg. or more of Sparine, 100 mg. or more of Demerol, and 100-180 mg. Seconal.
N=13	Group IV	General anesthetic during delivery

The mean scores for each group for each day on each item were then graphed and these graphs are attached as Figures 1-27. While we have not yet carried out any statistical analyses a preliminary inspection of the graphs indicates that there are two major trends: 1) Infants whose mothers had no drugs tend to perform at a higher level, especially in the first few days in the area of alertness; and 2) Infants whose mothers have had general anesthesia tend to show depressed performance on many items. The depression is most noticeable on items involving responsiveness to external stimulation, next on items involving infant self-control, and least on the motoric items. All of these trends especially characterize the first four or five days of life though some of them seem to persist through the first month.

Insert Figures 1-27 about here

We expect to look at the data from several perspectives and to make several different kinds of statistical analyses in order to understand fully the implications of the data. As each infant becomes one year of age we are administering the Bayley Scales of Infant Development in order to see what relationships might exist between the Brazelton newborn assessments and the Bayley.

There are several problems already apparent in the data we have collected. The uneven distribution of numbers in each group is bothersome. Even with the growing activity of the Lamaze movement for drug free deliveries the numbers we are able to obtain are very small. It is difficult to seek these cases out especially without signallying the testers that these are special cases. The Principal Investigator has plans to pursue this matter in a way that might produce the desired number of cases and appropriate controls.

Experimental Laboratory Analyses of Infant Discriminative Abilities

In the last six months we have brought two experiments to completion and begun or continued six experimental analyses. The studies concern three questions: discrimination and use of language stimuli in young infants; discrimination and use of visual stimuli in young infants; and individual differences in attending behavior.

General procedures: All of the experimental analyses use the same basic procedures. These procedures involve the presentation of a visual stimulus with duration controlled by infant attending behavior (Horowitz, Paden, Bhana, Self, 1972)/ The stimulus remains on as long as an infant looks at it. It goes off whenever a consecutive period of two seconds of no looking time has been recorded. Following offset the same stimulus is re-presented until another two seconds of no looking occurs. This is repeated until the duration of looking has declined to half the mean of the first two fixations. (This criterion was arrived at empirically. See Laub, 1972 and previous discussion). This criterion must occur two consecutive times. At this point response decrement is said to have been reached and the experimental manipulation for experimental subjects is introduced. For control subjects no experimental manipulation is introduced. If a reliable increase in fixation occurs after the experimental manipulation has been introduced then the event is said to have successfully "recovered" looking time and thereby acted as a functional stimulus for controlling attending behavior. It can also be inferred that the experimental event introduced is discriminable. Discriminability is inferred from two sources: 1) a reliable increase in looking behavior following response decrement for experimental subjects and 2) no reliably increase in looking behavior following response decrement for control subjects.

All sessions use two observers and reliability of observations is always calculated. While many infant laboratories study infant visual fixation behavior cite previous reliabilities our data indicate (see Table I) that once an observer is trained he or she is not always a reliable observer. Many factors probably affect reliability of visual fixation observations and it seems to us imperative that reliability always be taken. By tracking reliability one can catch declining reliability and arrange for retraining of observers. Additionally, the reliability figures will give some implication of the problems that might be encountered in attempts to replicate results. Thus, the added expense of two observers for every experimental session seems a scientific necessity if we are to have any confidence in our data.

I. Studies of Discrimination and Use of Language Stimuli by Young Infants

For the young infant the voices of people, especially the voice of the mother may function as one of the most important teaching and information providing stimuli in his/her environment. There has been little systematic research with very young infants to elucidate what functional control human voices may have on infant behavior. The two experiments reported here attempted to assess the effect of the mother's voice upon infant attending behavior. (Experiment I has been reported by Culp, 1971 and was included in a previous progress report but is repeated here because it is inextricably linked with the experiments that follow).

Experiment I

Subjects: Six males and two females visited the laboratory beginning at eight weeks of age. Three males and one female were assigned to the experimental group and three males and one female were assigned to the control group.

Apparatus: A three-sided brown masonite experimental booth as shown in Figure 28 was used. A Kodak Carousel projector was automatically

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Insert Figure 28 about here

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programmed to present slides by rear screen projection such that the size of the projected slide was 6 in. x 6 in. Solid state programming equipment linked the observers' keys to a 20-pen Esterline Angus Event Recorder and to the projector such that off-set of the keys for two consecutive seconds offset the slide, injected an inter-stimulus interval of approximately two seconds and onset the next stimulus.

Stimuli: The visual stimuli were four black and white checkerboard slides containing 4, 64, 256, and 1024 squares and one grey color slide. Each stimulus was presented twice in a session in a modified random order in which the first five presentations contained all five stimuli as did the second five presentations.

A tape recording of the mother talking naturally to her infant (which had been previously recorded in the home) served as the auditory stimulus. Repetition on each mother's tape varied from one half minute to two minutes. During the auditory condition, the voice stimulus was presented simultaneously only with the 4 and 64 square checkerboard stimuli.

Procedure: Subjects came to the laboratory once a week starting at eight weeks of age and continuing until criterion for Group I subjects or until 14 weeks of age for Group 2 subjects. Group I subjects (experimental Ss) received an ABAB design. During Condition A the slides were presented each week until each subject had reached the criterion of no look to any one slide of more than 120 seconds. After criterion condition B was introduced the following week. During Condition B the tape of the mother's voice was presented with two of the five slides: the 4 and 64 checkerboard square stimuli. The other slides were presented as in Condition A, with no voice accompaniment. The control subjects were presented with the slides each week for seven weeks without any special auditory stimulation being introduced. Except for these special procedures the general laboratory procedures described earlier were in effect.

Results: The response measure was the total fixation time in seconds for each stimulus presentation. The mean over-all reliability for observations of all subjects was .95 with a range of .84 to .99.

A Mann-Whitney U test (Siegel, 1956) was used to analyze the group data based upon a significant Bartlett's test (F 6.74, df 3/1000, p. 01) indicating a lack of homogeneity of variance. The data that were analyzed are graphed in the top half of Figure 29. The mean looking time

Insert Figure 29 about here

to each stimulus for the two criterion sessions of Condition A for the experimental subjects were compared to the mean looking time to each stimulus for the two criterion sessions of Condtion A for the control subjects. The results were not significant indicating the two groups prior to criterion were relatively equal. During Condition B however, the experimental subjects showed significantly longer looking times to both of the voice-paired stimuli than did control subjects to the same stimuli after criterion but with no voice added. Additionally, experimental subjects had longer average looking times to all stimuli during Condition B, compared to control subjects who, during Condition B had no voice added to any stimuli. An inspection of the individual data indicated that all four of the experimental infants showed an obvious increase in looking the first week the voice was added while no control infants showed any increase in looking time after criterion had been met.

Experiment II

Subjects: Six males and two females visited the laboratory once a week beginning at eight weeks of age. Three males and one female were assigned to the experimental group and three males and one female were assigned to the control group.

Apparatus: Same as described above

Stimuli: Same as described above.

Procedure: Same as described above except that this experiment was conducted with the BABA conditions in effect. That is, experimental subjects received a tape of their mother's voice played with the 4 and 64 square checkerboard stimuli in the first sessions until criterion had been met and the week following the two criterion sessions the voice was removed. Control subjects also began with the mother's voice accompanying the 4 and 64 square stimuli but after criterion had been met the voice stayed in for the entire seven weeks.

Results: The data for Experiment II were analyzed using the same procedures as described in Experiment I. The data graphed in the bottom half of Figure 29 were analyzed in the same manner as was used in Experiment I.

Insert Figure 29 about here

The results of the Mann-Whitney U test indicated neither the subtraction of the voice or the control condition (voice throughout) resulted in an increased looking behavior to any of the slides once the response decrement criterion had been met.

Discussion: The results of the two experiments reported above indicated several things. Firstly, the addition, but not the subtraction of a tape of the mother's voice was effective in increasing visual attending behavior to visual stimuli that did not change. Thus, stimulus change per se, of the kind employed here could not account for the results. Secondly, this demonstration occurred across-session. That is, the experimental effect was shown using intervals of one week between sessions. With the repetition of stimulus conditions from week to week there was a steady decline in looking to the stimuli except on that week when the experimental manipulation was introduced for the experimental subjects. In a general sense this involved the use of an habituation paradigm across sessions. The fact that it was effective for infants who entered the experiment beginning at eight weeks of age is indicative of relatively long-term memory stage for infants this young.

The results prompted us to go further in the use of the mother's voice as a discriminative stimulus for increased visual attending behavior. The results of Eimas, Siqueland, Juscyk, and Vigrito (1971) and of Trehub and Rabinovitch (1972) indicated that infants could discriminate synthetic and natural voiced and voiceless stops (e.g., /b/ vs. /p/) when sucking was used as a response in a within-in session habituation paradigm. Encouraged by our across-session habituation paradigm and by the use of visual fixation as a response in an habituation paradigm with auditory stimuli we decided to investigate with-in session habituation of visual attending behavior with mother and stranger voices and to ask the question of discrimination of these two auditory stimuli (Boyd, 1972).

Experiment III - (This experiment is fully reported by Boyd, 1972)

Subjects: Twenty-four infants, 12 male and 12 female served as subjects in this experiment. Half the males and half the females were assigned to the experimental group and the remaining half to the control group. All the infants were caucasian and were an average of seven weeks, one day when they visited the laboratory for Session 1 and eight weeks when they visited the laboratory for Session 2.

Apparatus: The basic apparatus in this study was the same as described above.

Stimuli: A single visual stimulus of a 16 black and white checkerboard square was used throughout this study and never changed. The auditory stimuli were tape recordings of the infant's own mother's voice and the voice of a stranger reading the first verse of the Robert Louis Stevenson poem "The Swing". The same stranger voice served as the stimulus throughout the experiment for every subject and every session.

Procedure: Infants were brought to the laboratory at seven and again at eight weeks of age. They were placed in the infant seat and the black and white 16 checkerboard stimulus was presented. In Session I experimental subjects received four phases of stimulus repetition in an ABAC design. During the first phase (A) the single visual stimulus was presented over and over again, being offset each time two consecutive seconds of non-looking occurred and then onset again repeatedly until the individually defined subject criterion was met. This criterion was two consecutive looks of less than half the mean of the first two looks of the phase. In the event that this criterion was less than ten seconds, two consecutive looks of ten seconds or less constituted the criterion. In the second phase (B) the 16 stimulus was re-presented and whenever the infant fixated the stimulus one of the recorded voice stimuli was played. If the mother's voice was onset it remained the stimulus for phase B; if the stranger voice was onset it remained the auditory stimulus for phase B. In other words, only one voice was used in any particular phase. The third phase was a return to baseline, phase A and the fourth phase was phase C, where the voice stimulus was added. If the voice stimulus in phase B had been the mother's, the stimulus for phase C was the stanger's voice and vice versa. The order of presentation of the mother's and stranger's voices was counterbalanced between subjects. Control subjects were given four phases to the 16 checkerboard square without any auditory stimulus (AAAA).

list each observed event and its observed time of occurrence, and later keypunch the data for computer analysis. A more efficient and usually more costly method is to code the data directly onto computer-compatible form via keypunch, paper-tape punch, cassette, or magnetic computer tape coding apparatus.

A COMPREHENSIVE CODE FOR TEMPORAL ANALYSIS OF MOTHER-INFANT INTERACTION

Howard M. Rosenfeld

University of Kansas

KANSAS CENTER FOR RESEARCH IN EARLY CHILDHOOD EDUCATION

Project Code 1HOK01-2

Development of Social Competence

December, 1972

A COMPREHENSIVE CODE FOR TEMPORAL ANALYSIS OF MOTHER-INFANT INTERACTION

Project Director: Howard M. Rosenfeld

General Project Assistant: Virginia Stark

NIMH Trainee in Social Psychology: Gail Young Browne

Undergraduate Assistant: Ron Warman

Introduction

The following code was derived from the comprehensive analysis of 30 videotapes, each recording a session in a living-room and nursery type setting, lasting an average of 42 minutes. The tapes were of two mother-infant dyads, one covering the infant's ages 12 through 34 weeks (Dyad A), the other 9 weeks through 31 weeks (Dyad B). All events were scored for time of onset (and termination if specified), to closest ½ second. Categories generally represent the smallest meaningful units identified by multiple coders who repeatedly viewed the videotapes at real-time speed. Many original categories that proved to be unreliably communicable between coders have been eliminated (e.g., general motor activity of arm could not be discriminated from reaching toward distant objects), as well as those that could not be consistently scored due to variation in subject orientation relative to camera (e.g., smiles). Asterisk (*) prior to code symbol indicates the event has duration, and thus is to be scored with a "+" at onset and again with a "-" at termination. Hardware employed in the videotaping and coding at the mother-infant videotapes is described in Report 1HOK01-1. Computer programs for the analysis of the coded data, along with some illustrative results are presented in Report 1HOK01-3.

Rosenfeld

Coded Mother-Infant Video Tapes

	SESSION ORDER	AGE (weeks-days)	TREATMENT
DYAD A			
	1	12w-4d	Baseline
	2	14w-4d	Baseline
	3	15w-4d	Baseline
	4	17w-4d	Baseline
	5	19w-6d	No toys
	6	21w-4d	Baseline
	7	24w-4d	Mother ignores
	8	27w-5d	Baseline
	9	28w-3d	Mother ignores
	10	29w-2d	Baseline
	11	29w-4d	No toys, Mother ignores
	12	31w-3d	Baseline
	13	33w-3d	No toys
	14	34w-3d	Baseline
DYAD B			
	1	9w-4d	Baseline
	2	10w-4d	Baseline
	3	11w-4d	Baseline
	4	13w-1d	Baseline
	5	14w-4d	No toys
	6	16w-1d	Baseline
	7	17w-4d	Mother ignores
	8	18w-1d	Baseline
	9	18w-3d	No toys, Mother ignores
	11	24w-4d	Baseline
	12	26w-1d	Mother ignores
	13	26w-4d	Baseline
	14	27w-3d	No toys, Mother ignores
	15	28w-4d	Baseline
	16	29w-4d	No toys
	17	31w-4d	Baseline

NOTE: Session B-10 was not coded due to malfunctioning video equipment.

Rosenfeld

List of Objects

A	ball
B	mobile
C	clowns (2 different clowns - both hard)
D	infant or infant's body
E	mother or mother's body (including clothing, shoes)
F	pacifier
G	diaper
H	blanket
I	infant seat
J	infant seat belt
K	napkin, garbage pail
L	keys
M	paper bag, purse
N	bunny, elephant (both soft)
O	book
P	couch
Q	floor
R	table, cabinet, chair
S	magazine, newspaper
T	hammer (rattle)
U	coffee cup
V	musical toy
W	bottle
X	infant's shoe, shoe string
Y	microphone stand
Z	electric outlet, cord

NOTE: On following behavior code, objects are scored where indicated by blanks (.___).

Infant Code (I)

Visual Orientation

*I1. Visual orientation toward a particular object
Note: 1) Identify Object.
2) Do not score (a) if uncertain about object of orientation or (b) if looking is less than 1 second duration.
3) Score continuously unless infant looks away more than 1 second (except when looking is interrupted by postural shift, as in code category M5P).

Physical Movement

I2A Lean forward or sit up (Include partially effective efforts to lean forward or sit up while restrained or otherwise incapable of completing the act. Score each time infant sits up again after he has returned to a relaxed position for 1 second.)

*I2B Roll (while the infant rolls over); if new location results, code I2F instead.

*I2C Crawl (while the infant crawls)

*I2D Stand (while the infant stands and remains in one position for more than 1 second)

*I2E Walk (while infant walks)

(NOTE: For future studies we recommend adding squirming and withdrawal from mother's touch.)

Object Exploration

*I3A Active and passive manipulation (when the infant is touching, holding, or manipulating an object). Do not score (a) self contact except with his mouth, or (b) touching objects that are supporting him (e.g., mother, infant seat, blanket, table, floor). Score I3A (or I3B) continuously until I is no longer touching object.

*I3B Object in mouth (when the infant puts an object in his mouth)

I3C Kicking object (when the infant kicks an object for more than 1 second; object may be lying on his legs)

I3D Dropping object (when the infant drops an object so that it is out of his reach)

Vocalization

*I4A Coo (pleasant sounding phonetic vocalization, in contrast to following categories)

*I4B Coo-irritated (resembles a coo phonetically, but with an irritated tone)

*I4E Grunt (straining sound - more staccato than fuss)

*I4F Fuss (relatively long intermittent wails)

*I4G Cry (continuous hard cry)

*I4H Giggle-laugh

Note: 1) Score vocalization as continuous if pause is not more than 1 second and the category does not change.
2) Score predominant category in a long vocalization if the different category is not longer than 1 second.
3) I4B vs. I4F: If borderline, score I4B.
4) I4G: Do not score any other infant category during his crying.
5) In future studies, we recommend addition of "scream".

Adaptors

I5A Sneeze

I5B Cough

I5C Yawn

I5D Hiccup

I5E Choke

Sleeping

*I6 Sleep (when the infant appears to be sleeping, with his eyes closed, or is drowsily immobile; doesn't include wide-eyed staring).

Loss of Postural Control

I7A Falling over--sitting-I (when the infant is sitting and falls over because of his own actions)

I7B Falling over--sitting-M (when the infant is sitting and falls over due to the mother's movements)

I7C Falling down--standing (when the infant is standing and falls down)

I7D Falling--hurts self (apparently)

Note: We recommend collapsing I7's for analysis.

Mother Code (M)

Visual Orientation to Infant

*M1A Visual orientation toward infant (the mother is looking at the infant and her eyes are within the infant's peripheral vision)

*M1B Visual orientation toward infant--unseen (when mother is looking at the infant and her eyes are not in the infant's peripheral vision)

Note: 1) Flicks less than 1 second not scored.
2) If unsure as to her direction of looking and the infant is in her line of orientation, score M1A.
3) If unsure if she is in the infant's peripheral vision, score M1B.

Stimulus Contr[illegible]

*M3A.__Jiggles stimu

*M3B.__Jiggles stimulus with a part of infant's body

*M3C.__Moves stimulus closer, but not in infant's reach (if the infant were to extend his arm)

M3D.__Moves stimulus to within infant's reach (if the infant extended his arm)

M3E.__Moves stimulus to infant (where the infant has complete control of the stimulus and the mother has withdrawn her hand from the stimulus)

*M3F.__Moves stimulus away-within sight (where the mother moves the stimulus away from the infant and the infant is in a position where he can still see the stimulus)

*M3G.__Moves stimulus away-out of sight (where the mother moves the stimulus away from the infant and the infant is in a position where he cannot see the stimulus)

*M3H.__Picks up dropped stimulus and gives it back to the infant (when the infant has dropped a stimulus he has been engaging with to the floor, table, etc.)

*M3I.__Interrupts and restrains the infant's physical contact with an object (does not result in the infant losing the stimulus, only interference)

Note: 1) Always identify which stimulus she is controlling.
2) End scoring for durational categories when the mother's hand and/or arm have stopped either jiggling, interfering, or moving the stimulus closer or farther away.

3) M3A: If she inadvertently jiggles a stimulus while doing something else and the infant is in a position to see the jiggled stimulus, score M3A. If she is doing things like spreading out a blanket, unfolding a diaper, rustling through a paper bag, and the infant can see this activity, score this moving of a stimulus as M3A. If she claps her hands or uses her hand as a stimulus (points, claps, bangs) or uses feet in similar fashion, score M3A.
4) M3C vs. M3D: If unsure of the distance between the stimulus and the infant's reach, score M3C.
5) M3D - M3E: Score when she begins to bring the stimulus to the infant.

Vocalization

*M4A Arousing (animated quality of speech-beyond the normal conversational level, variation in pitch beyond normal range-variation typically is in an up direction or up-down and is smooth, loudness beyond normal; includes exaggerated baby talk)

*M4B Soothing (smoothly declining pitch, slow and drawn out, sympathetic content)

*M4C Negative (irritated tone, sharp, sudden, staccatto-like, may have descending pitch, threatening content)

*M4D Neutral (conversational-type voice, includes slightly animated whiney or resigned quality, can be supersoft)

*M4E Questioning (rising terminal pitch-ending,request-type content)

*M4F Whistle-click (whistling, clicking, hissing sounds)

*M4G Imitating (apparent copying of infant's preceding vocalization)

*M4H Singing

*M4I Nursery rhyme (a rhythmic, stylized nursery rhyme)

*M4J Laugh-chuckle (score even if it sounds like a pseudo laugh or chuckle)

Note: 1) Score continuous if pause is not more than 1 second and the category does not change.
2) Score predominant category in a long vocalization if the different category is not longer than 1 second.
3) Score M4D for borderline vocalizations.
4) Suffixes for M4
,1 = contains infant's name
,2 = directed toward other person than infant
5) For future study, we recommend adding whisper and mocking tone.

Relocation of Infant

M5A Hold on lap-distant (infant sits on her lap and is closer to her knees than to her torso)

M5B Hold on lap-close (infant sits on her lap and is closer to her torso than to her knees)

M5C Hold in front (mother holds infant in front of her with her arms outstretched and the infant's feet are not supporting him)

M5D On torso-distant (mother holds infant next to her torso and their heads are close, but not touching)

M5E On torso-close (mother holds infant next to her torso and their heads are touching)

M5G. Standing (mother stands infant on an object)

M5H Carry-walking (mother walks while she is holding the infant)

M5I Carry-standing (mother is standing and holding the infant)

M5J Sits down (mother sits down after walking and/or standing and she is holding the infant)

M5K. Sitting (mother moves infant to a sitting position on an object other than herself)

M5L. Face up-lying (mother moves the infant to a face up-lying down position on an object other than herself)

M5M. Face down-lying (mother moves the infant to a face down-lying down position on an object other than herself)

*M5O Toward her (mother moves the infant toward her but does not pick him up)

*M5P General shift (mother rearranges and adjusts the infant's posture while she is holding him or he is positioned on something else that does not result in the infant being relocated to a new position)

Note: 1) A relocation is scored when (a) the mother's body adjustment results in a new position for the infant, (b) the infant moves by himself and a relocation category results, (c) the mother moves him and a new position results, or (d) if the new move results in the same position (for instance, if the mother stands him on the couch, and then moves him to another part of the couch, still standing, score the same position each time she moves him).

2) Onset is scored (a) when to move the infant, the mother has her hands under his armpits, (b) at the start of the action by which the mother or infant move themselves so that a new position results, (c) at the start of the action by which the mother starts to stand up, sits down, or stops walking and stands, or vice versa, or (d) at the start of her movement when the relocation category remains the same. For nondurational categories, time in new location is implied by time of onset of next location.

3) M5A-M5B: Includes mother or infant leaning forward or backward.
4) M5G, M5K, M5L, M5M: Identify which objects he is put on and/or into.
5) M5H: Score during any steps taken by the mother.
6) M5I: Score if standing lasts for more than 1 second; don't score if the mother is in the physical adjustment period of sitting down.
7) M5J: Score the infant's position after the mother has gotten seated.
8) M5P: Includes such acts as tipping the infant seat forward or backward. Don't score when M has moved I to new position and gets him settled.

<u>Physical Contact</u>

*M6A Touch (when the mother's hand is placed on a part of the infant and remains stationary for more than ½ second and is not there to support him)

*M6B Jiggle with hand (when the mother's hand somewhat roughly jiggles or shakes the infant)

*M6C Jiggle with body (when the mother somewhat roughly jiggles, shakes or bounces the infant with her body, e.g., bouncing him on her knees)

*M6D Rock (gently)

*M6E Pat/rub (gently)

*M6F Burp the infant

*M6G Tickle-pinch (with mother's hand)

*M6H.__Tickle-pinch-other (with an object)

*M6I(.__)Stylized game (mother uses infant's limbs to play the game, e.g., "so big", "patty cake")

*M6J Ties shoes-brushes hair of infant

*M6K Support (mother's hands support the infant and he is not in positions M5A - M5J); score when 5G, except 5G.E.

*M6L Change diaper (when the mother changes the infant's diaper)

*M6M Hug

*M6N Pacifier (mother places a pacifier in the infant's mouth)

*M6O Wipe body (mother wipes the infant's mouth, face, hands, etc., with diaper, etc.)

*M6P Kiss-nuzzle (rough or soft)

*M6Q Pull and adjust clothing (mother tugs and pulls down the infant's clothing, apparently to adjust his clothing)

*M6R Remove restraint (mother removes an object that is restraining the infant, e.g., infant seat belt)

*M6S Restrain (mother restrains the infant's limbs or body movement, e.g., holding his arm down)

*M6T Feeding-duration (when bottle is placed in I's mouth, until it is removed)

Note: 1) Score onset at the start of the move that results in the physical contact.
2) Score all categories continuously unless a pause is more than 1 second.
3) M6H: Identify object used.
4) M6I: If M uses object in game, e.g., diaper in "peek-a-boo", identify object.

Spatial Relocation

*M7A Moves to infant-distant (when the mother moves closer to the infant to a position that requires or would require walking or crawling for contact)

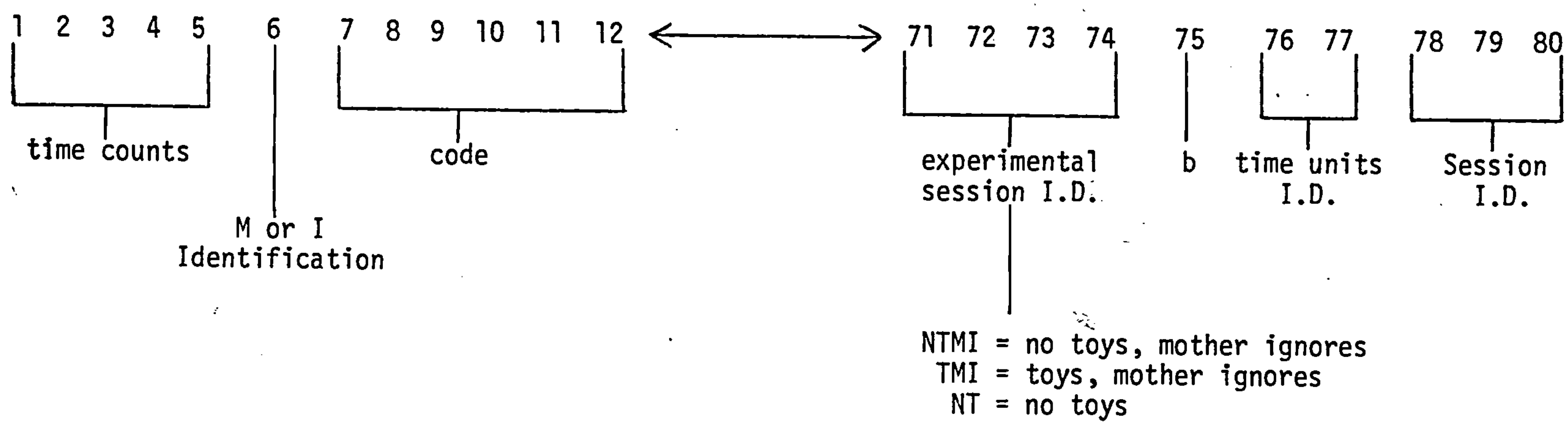
*M7B Moves to infant-close (when the mother moves closer to the infant to a distance where she is close enough to touch him with her arm outstretched)

*M7C Moves away-distant (when the mother moves away from the infant to a position that requires or would require walking or crawling for contact)

*M7D Moves away-close (when the mother moves away from the infant to a distance where she is close enough to touch him with her arm outstretched)

Note: 1) Score onset when she begins the move.
2) Score offset when she has stopped moving closer or away.
3) M7B + M7D: Don't score if infant is in positions M5A-M5J.
4) M7A + M7B: Don't score if move results in activity with the infant.

IBM CARD CODING FORMAT



COMPUTER ANALYSIS OF TIME-CODED MOTHER-INFANT INTERACTION

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Development of Social Competence

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COMPUTER ANALYSIS OF TIME-CODED MOTHER-INFANT INTERACTION

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Introduction

The primary purpose of this project was to develop computer programs to aid in the rapid and efficient analysis of complex social interaction processes. Most of the programs to be described were developed in particular for processing data from the type of coding system described in Report 1HOK01-2 - data that are multivariate, binary, and time-series. The coded data consist in alpha-numeric symbols, hierarchically labeled, with each observed event tagged by time of onset and termination. The programs range in function from simple preparations of data for further computer analysis, to the analysis of distributional properties and temporal relationships of variables. Relatively heavy emphasis is placed on the detailed distributional analysis of elementary data categories on the assumption that little is known about the functional organization of infant social behavior (in relative contrast to adult behavior).

The present report lists programs that are being applied to data from the mother-infant study referred to in Report HOK01-2. The programs are in varying states of development, and are likely to be further revised as we obtain additional evidence of their contribution to our understanding of social interaction processes. Our aim is to organize them all in a standard FORTRAN format. Qualified investigators interested in the possibility of submitting their own coded data to the programs on an experimental basis should write to the project director. The current report also includes a brief description of an additional "automation" approach to the computer analysis of the mother-infant data, currently being developed in cooperation with members of the Electrical Engineering Department at the University of Kansas. Finally, some illustrations will be presented of substantive results of computer analyses that have already been applied to the mother-infant data.

Outline of Current Computer Programs

The programs listed below are categorized by their major functions in the present project, and in approximate sequential order of their usage. Those marked MBT (for "Multivariate Binary Time-series") were developed in conjunction with this project.

Data Preparation

UTILITY: a standard routine for transfering coded data from punched cards to magnetic tape (A); also supplies a count of the number of observations coded in each data set.

MBT06A: data sets from Tape A (above) are sorted by event time and written on a new tape (B) by event name, time, and on-off designation.

MBT12A: data sets from Tape B (above) are sorted by code category, with events in each category sequentially sorted by time of occurrence.

MBT07D: sequencing errors in coded data are detected and listed, and preliminary corrections are provided for four kinds of sequencing errors; also all symbols occurring in a set of data are listed to permit visual scanning for illegitimate symbols.

MBT09A: card files are manipulated on tape, including insertion, deletion, and replacement of cards.

MBT01G: translation of alpha-numeric code symbols to binary data.

Listing and plotting of data

MBT11A: coded events are listed by time of occurrence, with symbol and on-off designation.

(MBT12A): aforementioned sorting program, which also lists sequential events per code category, by symbol, time, and on-off designation.

SFA47E: multivariate code categories are plotted in parallel by time-series of event occurrences.

General Summarization of Event Frequency Distributions

MBT07D: listing of coded events by hierarchical tree structure of code, with frequency of observations, total time of occurrence, average duration of occurrence, mean time of occurrence and associated U statistic.

Univariate Time-Series Analysis of Event Categories

MBT14A: univariate Markov analysis--comparative N-way tests of the predictability of temporal on-off patterns of a code category by fixed elementary time units.

Univariate Time-Sequence Analysis of Event Categories

MBT17A: distributions of various temporal features of a code category over fixed elementary time units, such as off-on ("starts"), on-off ("stops"), off-on-off ("spikes"), and off-on-on ("real starts"); and transformation of time series to time sequence form.

MBT15B: determination of "break-points" in distribution of an event category over blocks of elementary time units, in terms in change of density of occurrence (Note: a possible basis for redefining what is a variable).

Multivariate Time-Series Analysis of Event Categories

MBT04B: Markov analysis of replicated patterns of events, over specified fixed-time periods and specified lengths of sequences of periods.

MBT05A: printout of multivariate transition matrices, in order of frequency of occurrence, along with first, last, and normative mean times of occurrence.

MBT05C: printout of multivariate transition lists (time of occurrence of each event in above patterns).

Multivariate Time-Sequence Analysis

MBT18A: histograms of adjacent event distributions, reflecting normalized temporal relationships between pairs of variables (as defined by above time-sequence analyses of individual event categories); also plot raw time sequence data and calculate statistics measuring amount and pattern of adjacent influence.

SFA52C: clustering of above histograms.

Nonsequential Multivariate Analysis

MBT16A: simultaneous occurrence of pairs of variables over specified fixed-time units, with corrected Chi Square values.

SFA01E: cosines of angle between all possible pairs of binary time series variables.

SFA03E: application of principal components factor analysis, for large data sets, to cosine matrix.

Development of an Automation Approach

In addition to applications of the preceding programs, the computer analysis of mother-infant interaction is being approached from an automation viewpoint. Members of the Department of Electrical Engineering at the University of Kansas are developing computer programs that will combine concepts and procedures for pattern recognition and systems control, thereby to provide a model of the mother-infant relationship from our time-coded data. The automation approach models the mother and infant each in terms of a finite set of multivariate states. While in any one of these states, the mother or infant can receive an input from the other person, causing both a change in the receiver's state, and the generation of an output by the receiver. This output, in turn, serves as the input to the other person. Through this process of reciprocal influence, a matrix of state transitions can be constructed.

A variety of processing steps are necessary to construct the model from the sequential binary data coded from our videotapes. The time-series details of the data must be reduced to sets of sequential states. Thus, absolutely-timed elementary units of behavior must be translated into ordinal events, primarily by removing temporally redundant measurement vectors. The mother and infant states also must be reduced to a reasonably small number of classes via a clustering process. Finally the automation resulting from the input-output strings must be decomposed to provide a reasonably understandable model.

Some Results of Computer Applications

Distributions of Binary Data

An extremely large number of elementary event categories were coded from the videotapes of the two mother-infant dyads, as is evident from the empirically-derived coding system. The distributions of these categories over time varied widely along such dimensions as frequency of starts and duration, pattern of temporal distribution, and consistency of distribution over time. These distributional properties, both within and between sessions, have important implications for the kinds of analysis to which the data can be submitted. Thus much of our initial effort has been directed toward a detailed description of distributional characteristics.

Computer analysis is essential as an aid to human interpretation of complex multivariate distributions. This need is evident in Figure 1 which contains a computer-generated plotting of a small number of "tracks" within a brief time period of the first session of Mother-Infant Dyad A. The Markovian distributions of individual tracks frequently proved to be extremely complex, and thus we have been emphasizing other approaches. One helpful approach to identifying variables that can be studied for interpersonal functions has been to search for variables that do not occur at excessively high or low rates and which are not too closely bunched together. In this program, the distribution of adjacent temporal time units for a given event category is inspected separately for "starts" (off-on-on pattern), "stops" (on-off-off), and "spikes" (off-on-off). Some results from the first session of Dyad A are illustrated in Table 1.

Insert Figure 1 and Table 1
about here

From a more macroscopic perspective toward mother-infant interaction, it is important to identify variables that are reasonably well distributed across sessions. From a social learning viewpoint, it is particularly important to discover variables that increase or decrease in rate of occurrence over time, so that different trends can be related to differences in social contingencies. Figures 2 and 3 illustrate some infant behaviors that increased and some that decreased for both of the dyads over nonexperimental (baseline) sessions. (The locomotion category illustrated is a combination

Figure 1

Example of computer plot of a subset of variables
from Session 1 of Dyad A

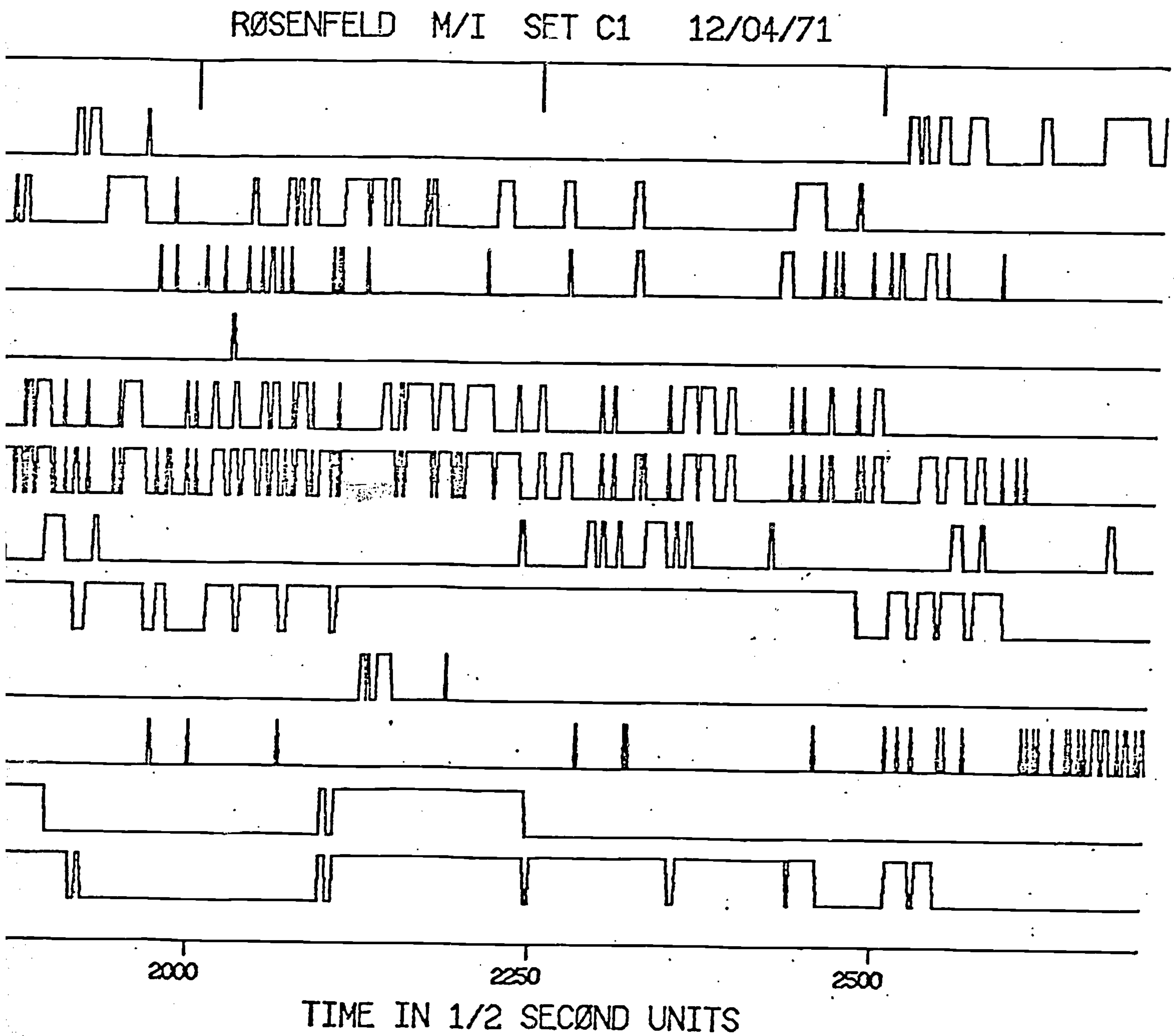


Table 1: Examples of computer selection of events meeting distributional requirements in Session 1 of Dyad A

RECORD OF CREATION OF TIME SEQUENCES
ROSENFELD M/I SET C1 01/23/73

INPUT VAR LABEL	FEAT NO	SEQUENCE LENGTH	OUTPUT VAR	PLOT NO	SEQUENCE (OR DELETE		
		CONT. OF	13		1517.1	1522.7	1529.5
					1761.3	1779.4	1788.5
					2405.6	2448.1	2456.6
16 M3A,B	2	37	14	47	401.2	418.2	536.7
					1519.9	1523.9	1530.7
					1751.9	1781.7	1790.2
					2409.0	2452.7	2461.2
16 M3A,B	3	2		48	NOT RARE EVENTS -- TOO FEW		
17 MCLOSR	1	18	15	49	427.9	555.4	735.0
					1752.2	1891.1	1913.2
17 MCLOSR	2	18	16	50	428.4	556.5	736.7
					1755.1	1892.8	1917.1
17 MCLOSR	3	12	17	51	1372.0	1487.0	1500.1
					2605.1	2687.3	
18 MFRTHR	1	28	18	52	439.8	621.7	1143.6
					1659.9	1671.2	1682.5
					2341.0	2380.1	2409.6
18 MFRTHR	2	28	19	53	440.3	623.4	1144.7
					1662.1	1675.2	1683.1
					2341.6	2381.8	2410.7
18 MFRTHR	3	0		54	NOT RARE EVENTS -- TOO FEW		
19 M4A	1	47		55	POINTS IN SEQUENCE TOO CLOS		
19 M4A	2	47		56	POINTS IN SEQUENCE TOO CLOS		
19 M4A	3	7		57	POINTS IN SEQUENCE TOO CLOS		
20 M4B	1	16	20	58	1278.5	1330.6	1342.5
					1973.8	1977.8	1983.4
20 M4B	2	16		59	POINTS IN SEQUENCE TOO CLOS		
20 M4B	3	0		60	NOT RARE EVENTS -- TOO FEW		
21 M4D	1	16	21	61	437.5	1302.8	1340.8
					1986.3	1993.7	2106.4
21 M4D	2	16	22	62	438.1	1304.0	1341.4
					1991.4	2012.4	2107.6
21 M4D	3	13	23	63	1166.3	1294.3	1319.3
					2384.1	2410.7	2706.6
22 M4F	1	77		64	POINTS IN SEQUENCE TOO CLOS		

of all locomotor events from the scoring system, and the object manipulation category combines varieties of objects and types of manipulations.) These distributions were derived from the program for determining the percentage of time units per session in which the activity was occurring, with the size of time unit set at one second.

Insert Figures 2 and 3
about here

By comparing the infant's behavioral trends over nonexperimental sessions to their rates of occurrence in interspersed experimental sessions, we provided immediate evidence of the degree to which the trend could be interpreted as a natural maturational progression, rather than an unexpressed ability of the child. In Figure 4, for example, it is clear that Infant A was capable of moving himself prior to starting such a trend in his seventh nonexperimental session (Session 10, age 29 weeks); in the first experimental session (Session 5, age 20 weeks), where toys were removed from the setting, the infant engaged in moving to new locations over 25 percent of the time!

Insert Figure 4
about here

<u>Temporal Relationships Between Variables</u>

We are applying three kinds of approaches to the analysis of temporal relationships between variables (particularly between infant and mother variables). While developing the computer programs previously described

Figure 2

Examples of infant behaviors the increased over nonexperimental sessions

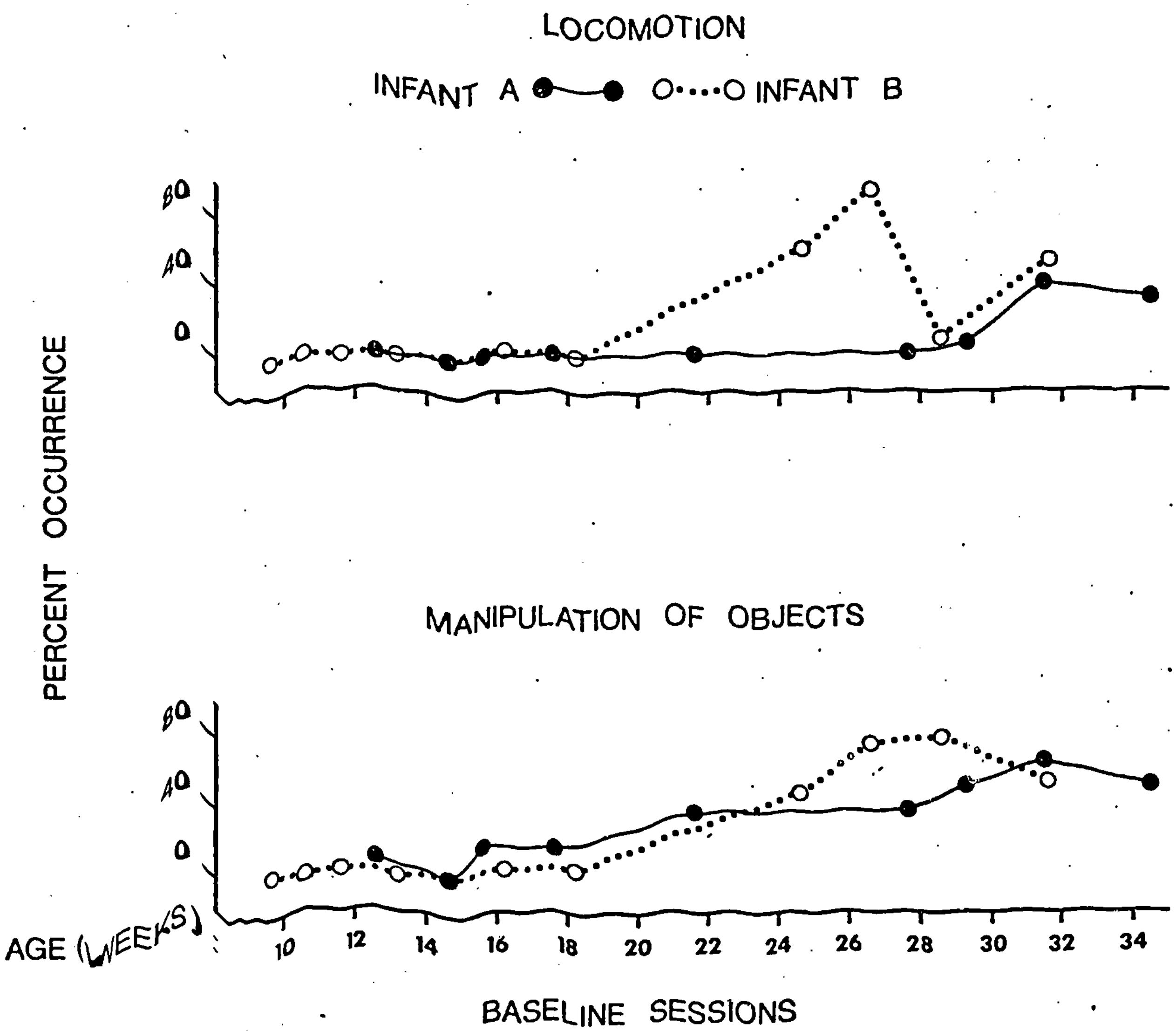


Figure 3

Examples of infant behaviors that decreased over nonexperimental sessions

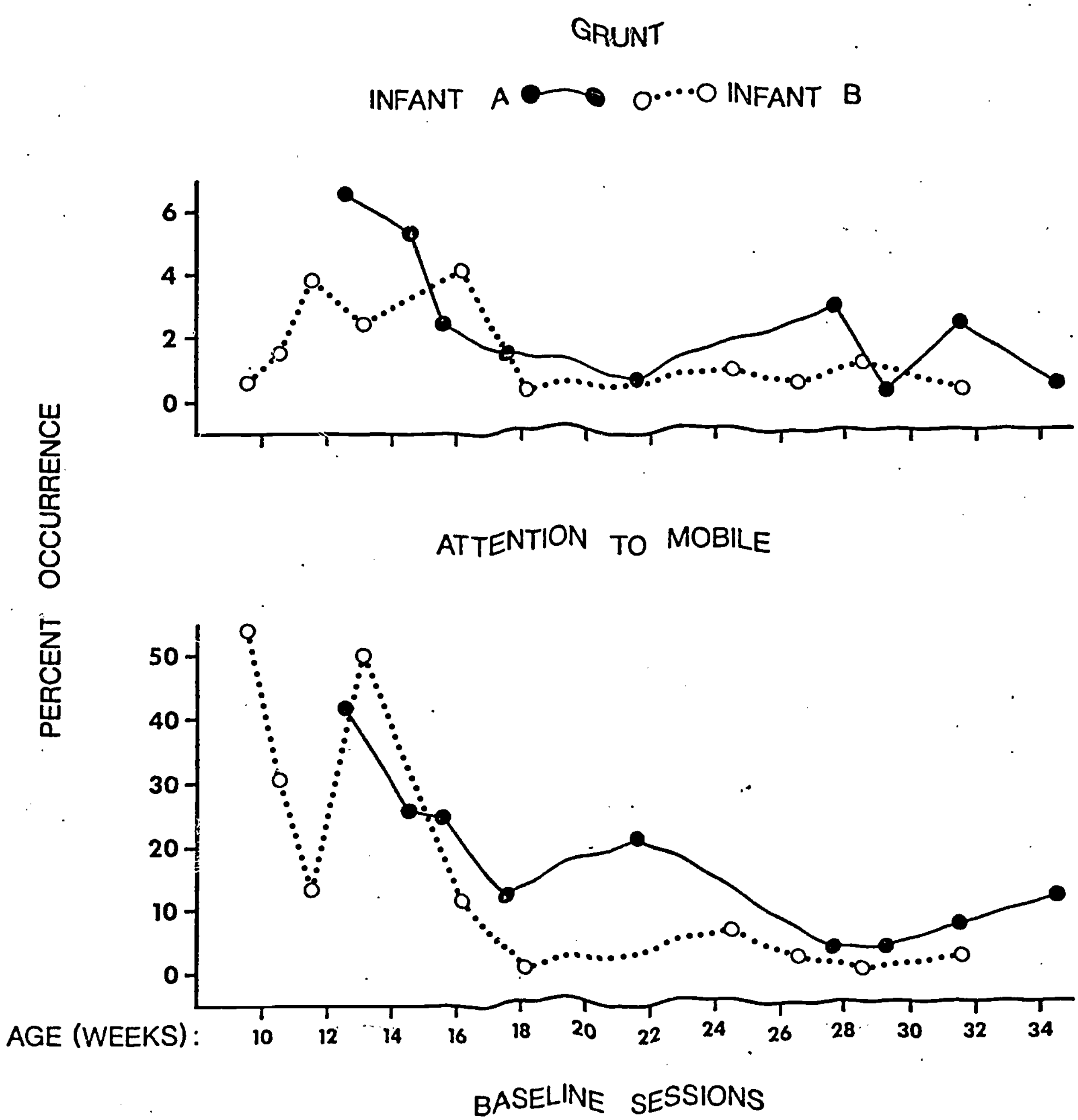
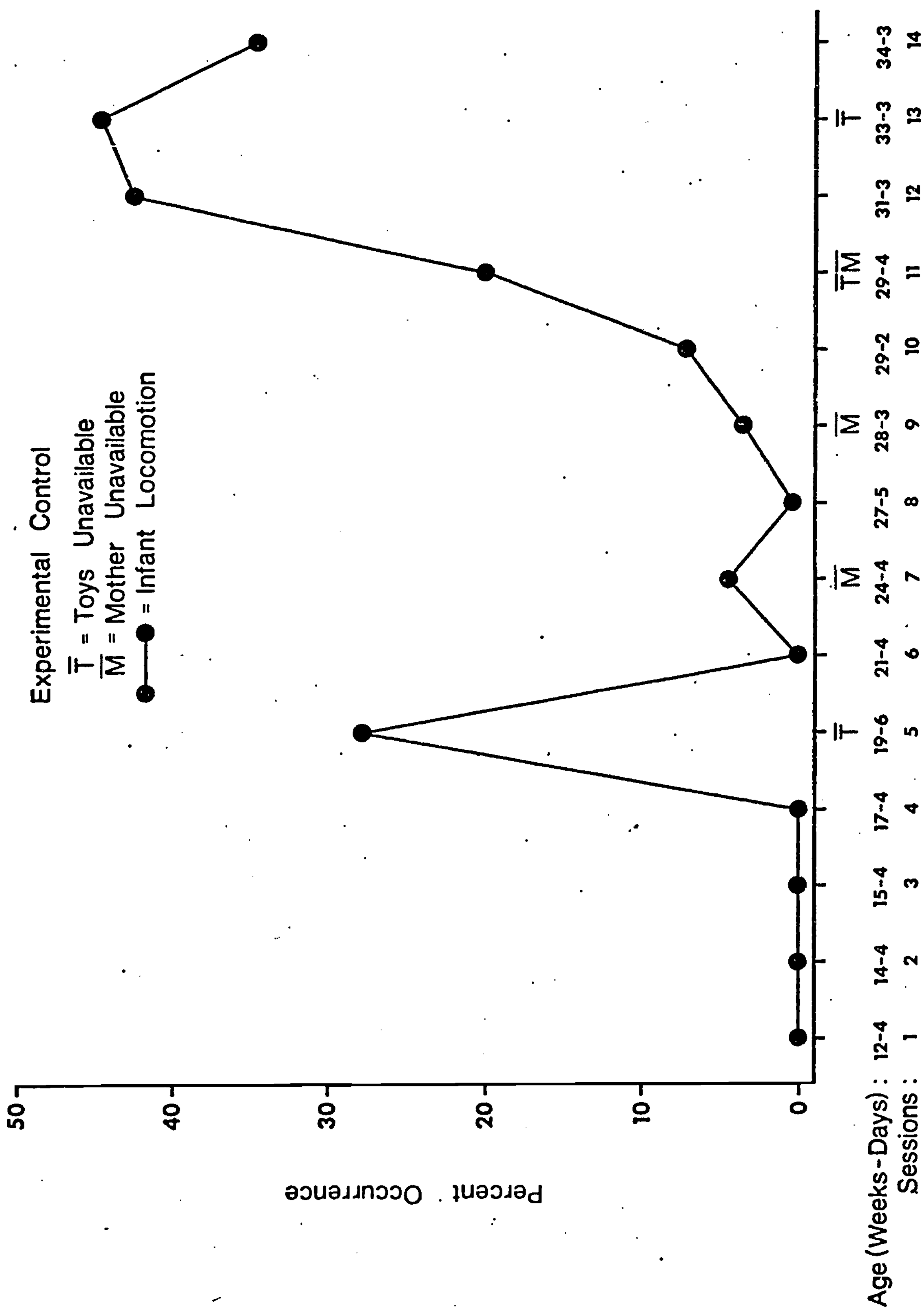


Figure 4

Effects of unavailability of toys and mother's attention on Infant A's mobility



in this report, a quasi-temporal analysis of maternal elicitors of infant fussing and crying throughout the study was carried out by Gail Browne. Separate periods of relatively persistent infant crying were identified throughout the data. Maternal events in the 25 seconds prior to each cry period were compared to those in randomly selected non-cry periods (random noncry) and to events in the second 25 seconds before crying (yoked noncry period). An existing computer program was applied (MAID, an adaptation by M. Gillo at the University of Kansas of the AID or Automatic Interaction Detection program of Sonquist and Morgan at the University of Michigan). This program searches for the levels of a set of predictor variables which combine to best account for variance in a dependent variable. The two infants differed considerably in configurations of maternal variables that differentially preceded crying. However, for both infants low levels of stimulation preceded crying, while a wide variety of stimulation preceded periods of apparent contentment. While the tree diagrams illustrating optimal combinations of predictors are too complicated to include in the present report, Tables 2 and 3 list the variance in crying accounted for by a set of individual maternal variables in Dyads A and B. The comprehensive programs being developed in the present project are expected to provide more precise evidence of the temporal structures and interpersonal functions of predictors generated by more traditional, nonsequential programs.

Insert Tables 2 and 3
about here

Table 2

Amount of Variance Explained by each Split Variable for

Random vs. Precry and Yoked Noncry vs. Precry Segments for Mother A

Variable	Percent Variance Explained	
	Random Noncry	Yoked Noncry
Removes Stimulus	16.0	12.1
Age	6.2	5.2
Passive Stimulus	5.3	4.7
Vocalizes	3.0	9.2
Gentle Tactile Stimulation	1.7	1.2
Relocates	1.6	0.0
Holds	1.1	1.5
Variety of Stimulation	1.0	6.4
Visual Stimulation (I)	0.0	5.3
Total Variance Explained	35.9	45.6

Table 3

Amount of Variance Explained by each Split Variable for Random vs. Precry and Yoked Noncry vs. Precry Segments for Mother B

Variable	Percent Variance Explained	
	Random Noncry	Yoked Noncry
Age	7.2	0.0
Variety of Stimulation	5.1	3.9
Vocalizes	3.6	4.5
Passive Stimulus	3.5	0.0
Visual Stimulation (H)	1.3	2.5
Removes Stimulus	2.7	2.0
Relocates	0.0	1.8
Total Variance Explained	23.4	14.7

Our current applications involve both time-series and time-sequence procedures, the former referring to sequential relationships of more molar sequential events that may vary in real-time properties. At the time-series level we are analyzing the entire array of coded data for multivariate transition states. The data have been subclassified into 28 variables for this purpose, listed in Table 4 (the variables are defined in Report 1HOK01-2). The program can be set to determine the occurrence of variables within time-units of any specified size, and to list combinations of variables over any specified sequential number of time-units. Table 5 illustrates multivariate states from the first session of Dyad A.

Insert Tables 4 and 5
about here

For the study of time sequences, we are segmenting individual variables into temporal periods in terms of changes in rates of occurrence. (One could conceive of different rates of occurrence of the same coded variable as indicating a set of different variables.) In addition, variables having well spaced and non-extreme distributions, as described earlier, are being tested for temporal relationship to each other by means of the new "histogram" program. Examples of pairs of associated variables are shown in Table 6. (Nonassociation would be reflected by a flat distribution; in the illustration shown, the one-sided slopes indicate that one variable tends to follow the other.) A revised version of the histogram program will check for the effects of differential rates of occurrence of the same variable on its relationship to other variables, thereby providing the advantages of both time-series and time-sequence.

Table 4

Twenty-eight variables selected
for time-series analysis

1) I1.E (look at mother)
2) I1.D, .X (look at self)
3) I1.B (look at mobile)
4) I1.A, .C, .L, .N, :T, .V (look at toys)
5) I1.Y, .Z (look at untouchables)
6) I1.F-K, .M, .O, .S, .U, .W (look at other objects)
7) I2A (lean-reach)
8) I2B-F (relocate)
9) I3A (handle objects)
10) I3B (mouth objects)
11) I3D, I5, I7 (misc. problems)
12) I4A, H (voice positive)
13) I4B, E (voice ambiguous)
14) I4F, G (voice negative)
15) M1 (look at infant
15) M3A, B (activate stimulus)
17) M3C-E, H; M7A, B (stimulus closer)
18) M3F, G; M7C, D (stimulus farther)
19) M4A (voice arousing)
20) M4B (voice soothing)
21) M4D (voice neutral)
22) M4E (voice questioning)
23) M4F-J (voice strange)
24) M5 (relocate infant)
25) M6B, C, G, H, I (rough stimulation)
26) M6A, D, E, K, M, P (gentle stimulation)
27) M6F, J, L, N, O, Q, T (caretaking)
28) M3I; M4C; M6S; M6U (interference)

Table 5

Examples of multivariate transitional states in Session 1 of Dyad A

```
MULTIVARIATE MARKOV ANALYSIS
LIST OF 'ON' VARIABLES FOR 3-WAY TRANSITION STATES ON 28 VARIABLE

ROSENFELD M/I SET C1  COLLAPSING TO 1 SEC.

ROWS ARE THE TIMES.  ENTRIES IN THE ROWS ARE THE 'ON' VARIABLES.


NO.       1           COUNT    389      NO.       2           COUNT    96
MTIME      763.7       NMT  0.164       MTIME      2181.9      NMT  0.791
FIRST    278.0       LAST  1256.0       FIRST  1288.0        LAST  2520.0
COX'S U -19.433                         COX'S U     9.485

1.   I1.B                               1.   I1.E   ,M1     ,M4E
2.   I1.B                               2.   I1.E   ,M1     ,M4E
3.   I1.B                               3.   I1.E   ,M1     ,M4E


NO.       4           COUNT     35      NO.       5           COUNT    31
MTIME      627.7       NMT  0.157       MTIME       947.2      NMT  0.286
FIRST    393.0       LAST  1179.0       FIRST    247.0       LAST  2195.0
COX'S U   -6.937                        COX'S U   -4.078

1.   I1.B   ,I4A,H                      1.   M1
2.   I1.B   ,I4A,H                      2.   M1
3.   I1.B   ,I4A,H                      3.   M1


NO.       7           COUNT     25      NO.       8           COUNT    24
MTIME      936.9       NMT  0.282       MTIME      1675.9      NMT  0.579
FIRST    304.0       LAST  1253.0       FIRST  1502.0        LAST  1878.0
COX'S U   -3.734                        COX'S U     1.329

1.   I1.B                               1.   I1TOYS,I3A   ,M1
2.   I1.B                               2.   I1TOYS,I3A   ,M1
3.   I1.B   ,I4B,E                      3.   I1TOYS,I3A   ,M1


NO.      10           COUNT     20      NO.      11           COUNT    20
MTIME      990.2       NMT  0.304       MTIME      1828.6      NMT  0.640
FIRST    325.0       LAST  1255.0       FIRST    242.0       LAST  2241.0
COX'S U   -3.011                        COX'S U     2.153

1.   I1.B   ,I4B,E                      1.   M1      ,M4E
2.   I1.B                               2.   M1      ,M4E
3.   I1.B                               3.   M1      ,M4E
```

Insert Table 6
about here

Further substantive results will be presented by the project director at the Biennial Meeting of the Society for Research in Child Development in Philadelphia, March 31 - April 4, 1973, in a Symposium presentation entitled "Time-Series Analysis of Mother-Infant Interaction."

Table 6

Examples of histograms showing relationships between pairs of variables in Session 1 of Dyad A

```
HISTOGRAM NO.   69            SEQ   7  WITHIN   SEQ   8
        0
        0
        0
        0
        0
        1 *
        0
        5 *****
        3 ***
       12 ************
FOR 21 INTERVALS IN SEQUENCE  8, MEAN INT, LENGTH =    84,87      STD, DEV, INT
POINTS IN SEQUENCE  7 =  21      POINTS OCCURRING SIMULTANEOUSLY IN BOTH SEQU

HISTOGRAM NO.   70            SEQ   9  WITHIN   SEQ   8
        7 *******
        8 ********
        1 *
        1 *
        1 *
        1 *
        1 *
        2 **
        0
        1 *
FOR  4 INTERVALS IN SEQUENCE  8, MEAN INT, LENGTH =   147,50      STD, DEV, INT
POINTS IN SEQUENCE  9 =  23      POINTS OCCURRING SIMULTANEOUSLY IN BOTH SEQU

HISTOGRAM NO.   71            SEQ  10  WITHIN   SEQ   8
        1 *
        2 **
        1 *
        1 *
        1 *
        1 *
        1 *
        4 ****
        1 *
        0
FOR  6 INTERVALS IN SEQUENCE  8, MEAN INT, LENGTH =   157,55      STD, DEV, INT
POINTS IN SEQUENCE 10 =  13      POINTS OCCURRING SIMULTANEOUSLY IN BOTH SEQU
```

FY 1972

December, 1972

Project:	Attentional Processes and Cognitive Styles in Toddlers and Preschoolers
Project Code No.:	3HOKO3
Principal Investigator:	John C. Wright
Contents of this report:	Overview of the Project
	K03-3 Introduction
	K03-6 Users' Manual for the KRISP
	K03-3 K03-7 The KRISP: A Technical Report K03-8
	K03-5 Salience of Dimensional Cues and Attentional Set in Children's Color-Form Matching
	K03-4 Habituation of Concept Stimuli in Toddlers

Note: Two additional sections, referred to in the Overview, are to be submitted as a progress report due February 28, 1973. They are:

1. Five experimental studies in progress.
2. Four studies in planning.

ATTENTION AND COGNITIVE STYLES

John C. Wright

Principal Investigator

I. Overview

The project on Attentional Processes and Cognitive Styles in Young Children's Learning has concentrated during the past year on the development of a cognitive style assessment instrument for three- to eight-year-olds and on a series of studies designed to evaluate the role of stylistic and attentional processes in the development of various cognitive competencies in young children.

The Kansas Reflection-Impulsivity Scale for Preschoolers, or "KRISP" (Wright, 1971) was initially developed as a research instrument for use with children younger than can be effectively tested by the matching Familiar Figures test (MFF) developed by Kagan (1966). In the past year some preliminary norms have been established, resulting in a manual for users which now makes the KRISP useable by untrained personnel. (Section 3, below). In addition to the manual, this report incorporates a technical report on the KRISP for other researchers, including inter-form, test-retest, and intertester reliabilities, age and sex differences, a one-year stability study, and a study of retardate performance on the KRISP. (Section 4, below).

The fifth section of this report contains two completed studies of attending behavior in young children. The first, on the role of salience and decentration in the development of color-form preferences (Wright, Embry, and Vlietstra) shows how the progressive decentration of attention with increasing age, combined with salience, locus, and sequence of cues, accounts for what has been claimed to be a maturationally governed shift of preference from color cues in younger children to form cues in older one. The second completed study, habituation of concept stimuli in toddlers (Faulkender & Wright), demonstrated a new method for the assessment of "protoconcepts" in three-year-olds, children too young to perform effectively on the kinds of verbal-conceptual tasks customarily employed with preschoolers, but old enough to demonstrate not only their possession and use of simple preverbal concepts, but also differential patterns of individually characteristic observing behavior that may bridge the gap between the differential habituation observed in infants (Horowitz, 1972) and the reflection-impulsivity styles assessed by the KRISP in older preschoolers. Because the new Faulkender & Wright procedure is based on the "iconic" level of representation and the sensorimotor level of thinking, it promises to be generally useful for future research in the neglected age range of from eighteen months to four years.

The sixth section of this report describes five studies in progress, all aimed at elucidating the development of attention or observing strategies as preverbal aids to young children's learning. Four of these studies are concerned in part with the interaction of saliency of cues, observing response bias or strategy, and relevency or informativeness of cues with the subject variables of age and/or reflection-impulsivity as determinants of children's cognitive performance. Two of the studies are concerned with memory, one with habituation and dishabituation of looking behavior, one with homologous comparison strategies in a same-different task, and one with a more conventional discrimination, but in the haptic modality.

Finally a seventh section describes four studies in the planning stages all designed to extend the findings of this program in various ways. One will test the validity of the KRISP in relation to a number of free-play observation variables, scores on other standardized tests, and motor skills. Another will begin a three-year longitudinal study of cognitive style differences using a population of toddlers on which Horowitz has previously recorded infant attending data and Brazelton (Neonatal assessment scale) scores. A third study investigates the effects of relevance of salient cues on performance in an eye-hand coordination task. A final study attempts to relate the differing formal or structural properties of children's television programs (Sesame Street and Mister Rogers' Neighborhood) to reflective and impulsive children's attending behavior in the presence of these programs.

During the past year several changes in funding and administration have hampered progress to some extent, but the shift of administration from USOE and CEMREL to NIE, effective March 1, 1973, and the restructuring of long term funding under a new Basic Program Plan, effective December 1, 1973, promise to expedite our progress in the current and future years. The new BPP will combine this research project with the Infant project directed by Professor Horowitz into a single, integrated program; and this change also promises to facilitate operations next year.

Progress on this project would have been impossible without the skilled administrative assistance of Ann Branden. Non-student supporting personnel include Melody Johnson, Steve Whittenberger, and Judy Larson. Graduate assistants employed on the project include Alice Vlietstra, Kenneth Shirley, Pat (Faulkender) Keaton, and D.J. Gaughan. Other graduate students with major involvement in the program include Kathleen McCluskey, Russ McClanahan, and Joanne Ramberg. Among the many undergraduate students

who have assisted on this project during the past year, those taking major research responsibilities were Charles Herrick, Lynne Embry, Janet Winchester, Teddy Jackson, April Waldron, and Ted Schlechter. The Director records his appreciation of the contributions of all of these persons and the cooperation of numerous school, hospital, and daycare administrators, teachers, and parents. Perhaps the biggest debt is owed to the children who diligently, patiently, and cheerfully played our games with us.

Introduction

A critical gap in our knowledge base concerning the development of cognitive competence and learning abilities exists between the ages of about two and five years. In particular, theoretical conceptions and teaching methodologies for use in this age range have been inadequate for the needs of the toddler and younger preschooler. This program of research has identified a number of points of departure for planned intervention that are promising in terms of what is known about pre-operational thought (Piaget) and iconic representation (Bruner), but which require supplementation of the knowledge base, invention of new training procedures, and special attention to individual differences in styles of information processing.

Specifically this program has been developing, field-testing, and norming a cognitive style instrument, the Kansas Reflection-Impulsivity Scale for Preschoolers (KRISP) (Wright, 1971), together with a manual for teacher-users (Wright, in press) that will enable early childhood workers in various settings to identify outstandingly reflective or impulsive children and to make corresponding individual diagnoses of the kinds of learning situations and tasks in which future learning problems may be anticipated. The second body of work is basic research on information-intake processes and attentional skills needed for adequate learning and development of cognitive competence in toddlers and young preschoolers. Our studies of the relationship of attentional strategies to effective discrimination learning and matching performance utilize age, sex, and reflection-impulsivity as independent subject variables, together with modeling, fading, and shaping procedures as independent experimental variables designed to build those repertoires of attending, visual analysis, scanning strategies, and the like that are needed for effective learning and memory. Thus both treatment and subject variables go into the experimental designs and are used to qualify the results. Furthermore, the dependent variables include effectiveness of observing and attending behaviors as well as rate and accuracy of correct responding. By the end of the program, some three or four years from now, we expect to have completed procedures for remediating extremes on the reflection-impulsivity dimension in those settings and tasks where difficulties may be confidently anticipated.

The outcomes programmed in order of their immediate availability for field testing and general use are thus: 1) the KRISP and associated user documents; 2) basic research on attentional processes in young children's learning to supplement the knowledge base selectively in those areas where it is both deficient and promising as a point of departure for intervention studies; and 3) training procedures for modification of style-related behaviors toward those demonstrated as being prerequisites for effective learning.

Children of equal intellectual ability often differ radically in the style with which they approach and solve problems. This is especially so in the many sorts of problems where early discrimination of relevant from irrelevant cues and consequent effective attention deployment are critical to solution. In particular, with tasks in which speed and accuracy (or attention to detail) are negatively related, about one-third of any sample of children are characteristically fast, but error-prone ("impulsive"), while another third are slower, but more accurate ("reflective") than the remaining average third of the group. Educators and psychologists have long been aware of these stable, generalized, and hard-to-modify individual differences among children, and recently a number of investigators have demonstrated both the generality and the developmental primacy of such differences (Kagan, 1963, 1964a, 1964b, 1965a, 1965b, 1965c, 1966a, 1966b, 1966c; Messer, 1970; Harrison & Nadelman, 1972; Massari & Schack, 1972; Reali & Hall, 1970; White, 1971; Katz, 1971; Odom, McIntyre & Neale, 1971; Loo & Wenar, 1971; Eska & Black, 1971).

The first effort in this program has been concerned with the completion of the Kansas Reflection-Impulsivity Scale for Children (KRISP) (Wright, 1971) together with a testing and scoring manual (in press) that will enable teacher and child-care specialist users to assess reflection-impulsivity in young children simply, accurately and reliably. The KRISP is also being tried out on samples of retarded children of a mental age comparable to the normal toddlers and preschoolers in order to determine whether they too show cognitive style differences that might constitute a source of interference with effective learning. Preliminary data indicate that degree of retardation has smaller effects on KRISP scores than does institutionalization (Wright, Segler, & Ramberg, in preparation). Assessment of the long-term reliability of the KRISP over a one-year span has begun, and a series of validation studies are being planned to relate the KRISP to the Bender Gestalt Test, sensorimotor coordination, and attention span vs distractability in free play settings.

One key to the effects of reflection-impulsivity upon cognitive development appears to lie in the demonstrated importance of patterns of attending behavior as determinants of information processing, especially in young children. Prior to the age of six or seven years, when verbal and concrete operational skills begin to mediate learning and thinking effectively, recent evidence has shown that conditions favoring selective attention to relevant and informative features of a task are especially helpful (Gaines, 1970; Nodine & Lang, 1971; Odom & Mumbauer, 1971; Odom & Guzman, 1972; Witte & Grossman, 1971; Lehman, 1972; Yussen, 1972; Wright, Emby & Vlietstra, 1972; Wright, 1972a). At the same time it has begun to be apparent that reflection-impulsivity as a cognitive style is related to visual analysis skills, and especially to effectiveness of search strategies and patterns of attention deployment (Drake, 1970; Siegelman, 1969; Zelnicker, Jeffrey, Ault, & Parson, 1972; Adams, 1972; McCluskey & Wright, in preparation). Viewed developmentally it appears that the child between two and five years explores his environment at first as a function of what is novel, salient, inherently interesting, or associated with past rewards, but not in any task-relevant or systematic way. Later in this interval, however, if conditions are favorable, the control of the child's attending behavior begins to shift to the logical requirements of the task at hand. An exploratory pattern is eventually replaced by a deliberate search pattern. Curiosity is supplemented by relevance considerations. Play gives way to a work orientation when the task at hand is understood and within the child's competence. A consummatory orientation toward task stimuli begins to be displaced by an instrumental orientation as looking behavior comes under the control of somewhat longer range goals (Hutt, 1970; Ruble & Nakamura, 1972; Sellers, Klein, Kagan, & Minton, 1972; Turnure, 1971; Wright & Vlietstra, in preparation; Wright, Embry, Winchester & Jackson, in preparation; Wright, Embry & Vlietstra, 1972).

Moreover, both skills and strategies associated with selective attention and the stylistic preferences referred to as reflection-impulsivity appear to be at least partly and temporarily (and maybe selectively) modifiable under experimental conditions (Briggs, 1966; Nelson, 1968; Yando & Kagan, 1968; Kagan, 1966d; Debus, 1970, 1972; Denney, 1972a, 1972b; Heider, 1971; Ridberg, Parke, and Hetherington, 1971).

Our thinking and research to date has therefore been focused on the ways in which young children learn selectively to attend to different sources of stimulation in the environment, these sources being distinguished by sensory modality, physical locus, salience factors, and logical priority. Under this heading, "attentional processes in learning", previous research with school age and preschool age children is being extended downward to the preschool and toddler levels. Concurrently certain systematic findings on attention in infants have resulted from procedures that appear to be extendable upward for use with toddlers, such as habituation (or response decrement) and recovery (dishabituation). We have begun utilizing these procedures in studies designed to assess and modify toddlers' "protoconcepts" as manifested by selective generalization of induced habituation (Faulkender & Wright, 1972).

Under the heading, "attentional processes in learning", we have addressed ourselves to the following basic research questions, both because they appear to be important, promising points of departure for effective intervention to enhance the development of cognitive competence and because it appears from the existing knowledge base that they are now becoming answerable questions: a) How do children acquire and flexibly generalize routines for finding informative cues and for discriminating relevant from irrelevant information sources from visual, tactual, and auditory arrays of stimuli? b) What experiences contribute to a transition from primarily stimulus controlled, salience-oriented <u>exploration</u> to subject-controlled, task-oriented <u>search</u>? c) Can scanning strategies and search routines be specified in sufficient detail and generality so as to make them communicable to children as young as two to five years of age? d) As a function of age and cognitive style, what methods are most effective for this training?

e) Once acquired, whether by specific training or by unstructured experiences in a comparably enriched learning environment, how broadly can such routines be generalized? That is, can the child apply them widely and flexibly to entirely different problems that nevertheless have the same formal and logical properties as those on which the routines were originally established? And finally, (f) How enduring are such routines or strategies -- how long are they retained without further prompting or training?

The answers to the above questions should enable us to attack more directly the question of cognitive handicaps associated with extremes of reflection-impulsivity. That is, on the basis of an improved understanding of the age changes in attending and observing behaviors and their relation to children's learning, we propose that it should be possible to train impulsive children at an early age to use certain more reflective, careful, thoughtful, and deliberate methods of approaching learning and problem-solving tasks. Thus our long-range orientation is toward early identification of extreme impulsivity (and in some cases reflectivity) together with development of remediation techniques for training effective, task-oriented search routines in children whose lack of such skills promises subsequent learning difficulties in more formal educational settings.

Objectives of Program

The long range objective is to be able to put into the hands of teachers and child-care workers a set of assessment instruments, training procedures, and facts about the development of attending skills in children of different ages and cognitive styles that will enable them to identify potential attentionally based learning problems early and to begin remediation of them differentially as a function of age and style.

In order to achieve this objective, it is necessary to complete norming of the KRISP on a large population of toddlers and preschoolers. First-generation norms are now in hand. The second generation will be based on considerably larger numbers of children, and may need to be stratified in terms such as urban vs. non-urban, socioeconomic status, as well as age, sex, and number of previous administrations of the scale. Inter-form, scorer, and test-retest reliability figures need again to be assessed with each new contributing population.

A second intermediate goal is to determine the accuracy and utility of our current theoretical model describing the processes involved in the developmental transition of observing behavior determinants that allegedly takes place in the years from age two to five. This is being accomplished by a series of experiments designed to compare trained vs. untrained, younger vs. older and reflective vs. impulsive children, on indices of systematic stimulus scanning and effective discrimination learning and memory. Among the training variables are included modeling and fading techniques, stimulus class habituation and dishabituation procedures, and the systematic manipulation of the salience of relevant and irrelevant stimulus features.

The third intermediate goal corresponds to the third research effort and forms a bridge between the first two. It is the modification of extreme and maladaptive cognitive styles in selected tasks by means of training in those attention deployment skills that appear from the studies described in the preceding paragraph to be both trainable and important for learning and memory tasks. This style training will be aimed not at reducing the range of reflection-impulsivity in any group of children, but rather at teaching children to discriminate those tasks requiring a more reflective approach from those that benefit from a more impulsive orientation, and to adopt the appropriate style for the task at hand. It is obvious that impulsive children have difficulties with tasks requiring careful analysis and convergent thinking directed toward a single "right" answer. Not so obvious is the possibility that reflective children are conversely handicapped when it comes to free expression in creative art, body-movement, story-telling, and other learning situations requiring divergent thinking and a high rate of relatively uncritical behavioral output.

These basic questions in a context of current research on attentional and stylistic differences in cognitive development serve to focus our concerns on the more applied issues of how to identify stable individual differences early and how to develop both stimulus materials and training programs that will demonstrably, reliably, and economically facilitate effective attending and learning for unique children in the stylistically and developmentally heterogeneous target population. We cannot expect what is most effective for three-year-old impulsive children to work as well with five-year-old reflectives. But we can expect this program of research to lead to the specification of the minimum necessary differentiation of training techniques and materials required for such a variable population. More ambitiously, we expect that tailoring search and scanning strategy training to categories of children that can be confidently identified in terms of developmental status and cognitive style will be more generally effective than using traditional variables like intelligence and social class for the same purpose.

Research Strategy

Younger toddlers, especially impulsive ones on the KRISP are more attentive to stimuli or stimulus features that are salient because of physical features (brightness, contrast, location, size, change or movement, complexity, novelty, etc.), while older preschoolers, especially reflective ones on the KRISP, have begun to respond under favorable conditions by analyzing, discovering, or at least looking for, relevant and informative features as defined by organization of materials and task requirements. Consequently the former tend to explore passively and erratically, while the latter tend to search actively and more systematically. Facilitation of this transition can be accomplished best in children who are ready to make it, and they, in turn should be identifiable by their pattern of time and errors on the KRISP.

The basic studies thus begin by identifying reflective, impulsive and intermediate children at the three-, four- and five-year-old levels. Typically these scores are coded so that all the staff are "blind" as to any child's KRISP scores until all the data are in. In most of the studies, a task, such as matching to sample, matching from memory, classifying, or simply discriminating compound stimuli, is devised which permits reliable recording of both attending behavior (eye movements, hand movements in a haptic task, or task, or slide changes under the child's control) and solution behavior (correct discrimination, matching, or classifying), which is usually directly reinforced. Then two or more groups of subjects, stratified on age and KRISP classification, are selected. One group receives attentional training on practice items by means of modeling, direct shaping of observing responses, or fading from stimuli that by design attract attention to relevant features, toward stimuli that contain the relevant cues imbedded in a distracting complex of irrelevant cues. At least one group receives equivalent practice and exposure without systematic training as a placebo. Results are analyzed using subject-type by treatment anova models, with particular attention to the interactions between subject variables on which the groups were stratified (age and style) and the various training vs. control manipulations employed.

What is uncommonly done in the literature, but is especially useful in these designs, is to analyze observing responses (attention and scanning) both as a dependent variable and as a co-determinant of the correctness of the child's final choice or decision. Thus we can establish when attention is indeed the intervening variable that determines the effects of subjects and treatments on learning, because when it so functions, the observing behavior we attempt to teach both improves and is correlated with terminal accuracy of response. If the training facilitates learning by some other means than improving observing behavior, that fact shows up in this design. Correspondingly, if the subject variables affect learning, either mediated by attending behaviors or not, but the treatments are not effective, that too is manifest in the results. Finally, the differential effectiveness of various training techniques for improvement of both search strategies and terminal decision making by the child can be assessed for each age and style group studied. Such treatments can thus be differentially prescribed for other children.

Children are typically studied one at a time in an experimental room or mobile laboratory set up typically with back-projection slide displays or haptic stimuli. Their eye movements or hand movements are recorded on, and scored from, video tapes. Their choice behavior consists usually of pointing to the required stimulus, rather than any verbal response. The child changes his own slides when he is ready in most experiments. Reinforcement consists of praise or tokens that may be exchanged for a prize. Many variations have already been wrung on this basic technique, and its most innovative features are simply the recording of visual scanning without physical constraints and the systematic design and careful production of differentially interesting stimuli.

For KRISP development, as many subjects as can be secured nationally from age two to eight are being tested. Age and sex are the norming criteria, and most of the data have come from middle-class suburban and small-town populations. Smaller poverty, inner-city, and minority samples are being collected as well, together with trainable and educable retardates between ages of five and thirteen, both institutionalized and living at home.

Standard preschool, kindergarten, and daycare populations of children from the Lawrence community are involved in the basic research program, together with older comparison groups from public school classes at the second- to fourth-grade levels when needed.

The ages most appropriate for style-modification and style-task differentiation training have yet to be determined precisely, but lie within the range currently under study as described above.

Summary

In the individual reports that follow, we believe are the seeds of an emergent model for new ways of matching the deliberately arranged features of early childhood learning environments, including home, day-care, and preschool, to the most important parameters of individual children: their level of information processing competence and the cognitive styles with which they typically approach new learning situations. Such a model will, we believe, eventually be able to make a series of periodic assessments of the child's status, not so much in terms of achievement as in terms of attentional sophistication and readiness for well defined types of tasks, and in terms of how best to present such tasks to children of a particular cognitive style and level of readiness.

If the first part of such a model is designed to match the educational environment to the particular child, it follows that a similar effort may also be needed to match the readiness of the child to the particular educational demands that are about to be made upon him, especially in those settings that are not equipped to adjust so readily to the unique individual child. Thus we stress the development of intervention procedures, eventually designed to help atypical children make the minimum necessary accomodation to an educational system that is increasingly less tuned to their unique needs and more to general standards of cognitive competence. Both kinds of matching efforts are required, and although we are farther advanced on the first, we are hopeful that the two-faceted approach our research has followed will continue to feed both kinds of efforts.

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Lenses: "Fast" lenses (those with low "f-stops") may be used to help offset inadequate lighting; but while extra-fast lenses let in more light, they have the disadvantage of going out of focus very easily at fast f-stops due to poor "depth of field". If lighting is marginal, such as through a one-way window, an inexpensive (less than $600) zoom lens may reduce light beyond a tolerable level. If so, and it is still necessary to vary the range of field during recording, some alternatives to a zoom lens are to use a rotatable turret containing different-sized fixed lenses, or to switch between mutiple fixed-position cameras each with a different sized lens. In the latter case, switching equipment must be added - a minor expense. A multiple camera setup also is useful when subjects can move out of range of a single camera.

Special effects generators: If simultaneous recording of two camera images is desired (e.g., a wide angle of subject along with a closeup of subject's face or two subjects sitting face-to-face), a special effects generator will be required. Features include splitting the screen with various horizontal and vertical proportions, and overlapping and fading of images. For example, the Sony SEG-1 at about $600 includes both options, as well as switching between four cameras, generating 2:1 sync signals (mentioned above) and reversing polarity of one of the images. In our laboratory we have successfully combined four separate camera inputs onto one screen by stacking three two-way splitters, at much less expense than would be required through the purchase of a four-way splitter. (See following discussion on "Genlocking").

Videotape recorders: Relatively inexpensive (less than $1,000) and versatile recorders can be purchased in the recent standardized EIAJ-1 one-half inch format (e.g., the Sony 3600 at about $700). If the machine is properly adjusted, tapes recorded in this format should be playable on any other properly adjusted recorder employing the same format, regardless of manufacturer. Earlier non-standard format recorders of high quality often can be purchased at greatly reduced cost, sometimes in quantity. If playback on a standard format recorder subsequently is needed, one can duplicate the non-standard tapes onto such a format. However, it is important to assure the availability of parts and repair facilities before investing in outdated models.

Duplicating: The capacity to duplicate videotapes, and modify and correct certain aspects of the recorded signals in the process, is useful for a variety of purposes. Straight duplications can generally provide multiple copies for distribution either in one's original format or a different format. (Sometimes, as in our own case, a format different from the original is optimal for particular coding purposes). In such cases, the original "master" videotape recording can be preserved with little wear for purposes of future duplications or archival storage. (See discussion below on "Tape").

In the process of duplicating, modifications and corrections of the original recording can be made. In our project, these modifications have included the addition of a visible digital time-count upon an otherwise unimportant part of the screen. We also have controlled the "white", "pedestal" and "sync" levels during duplication of the original record to provide better contrast and stability. Improved nonvisible synchronization (sync) signals were required so that tapes could be easily duplicated and later interfaced with computer operated equipment. Also high quality monitors require such processing to prevent "hunting" and "jittering" of the playback picture. (See discussion below on "Monitors").

Finally we have edited tapes to duplicate limited segments from various tapes in particular orders, with the addition of new descriptive information. This is a most significant aid to coding. (See discussion below on "Editing").

"Genlocking": To combine the playback of an original "master" tape with an additional input from a live camera (e.g., focused on a running time or frame counter) a special effects generator is needed which "genlocks" the live camera to the playback recorder and sends the combined signal to the duplicating recorder. (We built our own "Genlock" unit by modifying equipment intended for other purposes, but now one can purchase more efficient equipment commercially -- e.g., the Panasonic VY-922 at about $1,100). Initially we used a less expensive commercially available, non-genlock, split-image generator to superimpose the couter-image onto a corner of our recordings at the time we made the "master" tape. However, on occasion, useful subject images would be blocked by the image of the counter, and additionally the count rate was sometimes too fast or slow relative to the rate of occurrence of codable information. Thus the capacity to add inserts later -- during duplication -- is a definite advantage because both the count rate and the count image location may be varied as required. Only "Genlock" equipment allows these "after-the-fact" additions.

Processing equipment: To maintain signal quality during the duplication process, and occasionally to enhance it, a processing amplifier and waveform monitor are necessary. Duplication can be expected to cause at least a 20-40% deterioration in the signal quality, especially in the non-visible but extremely critical "sync" component of the signal. Equipment adjusted to less than optimum aggravates this problem. The results of such signal deterioration include graininess or "noise" in the visible picture, "servo-hunting" in the recorder making the duplication, and "tearing" and "jitter" in the monitors playing back the duplicated tape. Additionally, contrast may suffer greatly, audio may develop "sync buzz" and vertical and horizontal hold may become extremely unstable on playback monitors. These problems generally limit the number of duplications possible to one generation (one copy) from the "master" before the picture quality falls below that required for adequate duplication for analysis and coding.

Adequate processing amplifiers and monitoring equipment allow an indefinite number of duplications to be made, sometimes of subjectively better quality than the original "master". Such equipment should offer the features of "sync stripping", pulse insertation during the "drop-out interval", "equalization pulse" insertation, and controls for "sync", "pedestal" and "white" levels. Optional features of "white stretch", image enhancement ("comb filters" or "aperture correction"), and R.F. "drop-out" compensation are extremely useful to those who can afford the equipment. D.C. restoration is an absolute necessity. Unfortunately equipment providing these features is expensive. But while the need for such processing may not be obvious with the use of the less expensive monitors (such as those furnished with most recorders) multiple duplication and interface with high-quality monitors or data control equipment is virtually impossible without such preparations.

Properly adjusting and controlling such processing equipment requires both a "waveform monitor" oscilliscope and a technician trained in television signals and systems. For most users, it is essential that the waveform monitor be suitable for the unstable signals often found in helical-scan systems (Ultra-Audio #VW-0 provides an inexpensive model, but for the sophisticated data-control user, a unit such as the Tektronics #458 or #459 is necessary). It is stressed that there must be an operator available who is capable of interpreting the displays of such monitors and effecting the proper adjustments to the system.

Monitors: While most videotape recorder companies offer monitors to accompany their equipment, these monitors generally do not meet standards required for efficient and accurate coding. They are generally consumer products adapted to videotape, and offer poor resolution and inferior construction, as well as problems with availability of parts. For detailed analysis, high quality monitors with resolutions of at least 600 lines center are required. Screen size is optimally 12 inches to 18 inches, but screens as small as 9 inches and as large as 21 inches have been used with success. These high-quality video monitors (they do not receive regular broadcasts) demand correct "sync" levels, and provide no audio features, but their pictures are quite superior. (Ball Brothers - #TE-9 - and Conrac manufacture excellent monitors for critical applications; and Setchell-Carlson makes several models - #10M912, #10M915 - costing less, for routine applications).

Tapes: Videotape must be carefully chosen for the application being considered. Some tapes shed considerably and may clog video heads, but have excellent shelf lives and lubrication properties. Other tapes may produce good signal-to-noise ratios, but age quickly. Further, new developments in the videotape industry occur often and may change the properties of any one brand of tape. Constant reevaluation is required, sometimes as often as twice a year.

All tapes perform better if kept clean, stored properly, and handled carefully. Manufacturer's advisories should be religiously adhered to, and special storage cabinets can extend the shelf-life of an archive tape up to four years. At present, most videotape deteriorates markedly with more than 50-100 passes through the machine (counting rewinds) and after more than 12-18 months of less than optimum storage.

Editing: It is often very useful to be able to combine short segments of many "master" tapes into one duplication to be used in analysis and coding. Because of the complexity of the television signal, an "editing" videotape recorder is required to do this. While non-editing recorders can be used to make such a "stacked" duplicate, the servo-system and sync-signal interference which occur at the beginning and end of every segment not only disrupt the picture during playback, but make any further duplication impossible. Therefore, it is important to select the right kind of second videotape recorder upon which to make duplications. For purposes of interface to high-quality systems and data-control equipment, a recorder must have a "capstan-servo" editing function, with both "assemble" and "insert" modes (such as Panasonic #3130). Additionally, the machine should be capable of editing audio along with video (e.g., Sony's AV3650 does not edit audio with video).

Color: While color videotape recorders are not significantly more expensive than black-and-white-only tape recorders, color equipment is still contra-indicated at this time. Color cameras are still in the $10,000 range, color monitors of good quality are still in the $1,000 range, and the additional circuitry required for color generally makes color equipment about three times more complex than the equivalent black-and-white units. Since such circuits are unnecessary for black-and-white, they can only add to the complexity, expense and maintenance of the equipment. Further, the maximum resolution possible with color equipment is 240 lines, while black-and-white equipment routinely offers over 500 lines. For analysis and coding, this is to say that a black-and-white picture is about twice as detailed and well-focused as the best possible color picture. This is true of black-and-white pictures viewed on color monitors, as well.

Audio: While the primary emphasis of television is on the picture, the audio must not be slighted. High-quality low-impedance microphones are mandatory to minimize interference from room noise and to keep intelligibility high. High quality mixers (if more than one mike is required) must be used if hum and buzz are to be minimized; and during the duplication process, some sort of audio processing may be desirable to further enhance the intelligibility of the audio signal. For example, a hum filter may be used to eliminate sync-buzz, and a compressor-expander or AGC amplifier may be used to maintain uniform audio levels in spite of variations in the subject's loudness or position. As most videotape recorders and almost all high-quality monitors provide no audio features for listening, a low-powered amplifier (about 10 watts) and at least 6 inch speakers are required to monitor the tape during recording and playback. Headphones are often convenient, but must be carefully chosen to be comfortable for long periods of time and provide good fidelity.

Playing Videotapes for Coding

Slow-motion: For simple playback at real time with not too many starts, stops, and reverses, a simple, inexpensive, recorder (such as the Sony 3600) is sufficient. If slow motion is required, a more expensive recorder with capstan-servo operation of slow-motion is desirable for stability of images. While most relatively inexpensive recorders with slow motion are limited to variable speeds between stop and 1/3 of normal, it is preferable for some purposes to be able to vary the slow playback speed up to at least 3/4 of normal (e.g., to score "phonemic clauses" which optimally require about 3/4 speed for intelligibility along with stretching of pitch variations).

Also, the capacity for playing back at greater than normal speed without losing synchronization is handy for scanning for large slow movements. Assuming that most users will not have the funds to build a sophisticated video-retrieval system such as was constructed by Ekman and Friesen at the University of California in San Francisco, one can obtain equipment that usefully performs the above slow-motion functions, or which can be simply modified to do so, at a comparatively low price (e.g., the Panasonic NV-3130 at about $1400).

Remote control: In our experience, if coding systems and observed events require frequent starting, stopping, and reversing of tapes during playback, then it is preferable to have a recorder with remote electrical control of these transport functions. Mechanically controlled transports proved to become fatiguing and painful to assistants, and frequent operation of the mechanical controls tended to loosen or break them. Unfortunately, at this writing, we have not found reasonably-priced recorders in the 1/2-inch standard format that provide reliable remote control, with or without other desirable features listed above. For reduced wear and tear on coders and recorders we have been using obsolete and inexpensive Panasonic 204 1-inch videotape recorders, which have remote, bidirectional control of transport functions, though they permit slow-motion only from 0 to 1/3 normal speed. We duplicate segments to be coded from the master 1/2-inch tapes onto the Panasonic format for coding. While the 1-inch tapes for the Panasonic are more expensive, they can be reused after segments are coded. This process also avoids heavy wear and possible damage to out "master" archive tapes.

Coding: An inexpensive way to apply a multivariate time-based coding system (such as described in Report 1HOK01-2) to videotapes is simply to list each observed event and its observed time of occurrence, and later keypunch the data for computer analysis. A more efficient and usually more costly method is to code the data directly onto computer-compatible form via keypunch, paper-tape punch, cassette, or magnetic computer tape coding apparatus.

A COMPREHENSIVE CODE FOR TEMPORAL ANALYSIS OF MOTHER-INFANT INTERACTION

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Development of Social Competence

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A COMPREHENSIVE CODE FOR TEMPORAL ANALYSIS OF MOTHER-INFANT INTERACTION

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Introduction

The following code was derived from the comprehensive analysis of 30 videotapes, each recording a session in a living-room and nursery type setting, lasting an average of 42 minutes. The tapes were of two mother-infant dyads, one covering the infant's ages 12 through 34 weeks (Dyad A), the other 9 weeks through 31 weeks (Dyad B). All events were scored for time of onset (and termination if specified), to closest ½ second. Categories generally represent the smallest meaningful units identified by multiple coders who repeatedly viewed the videotapes at real-time speed. Many original categories that proved to be unreliably communicable between coders have been eliminated (e.g., general motor activity of arm could not be discriminated from reaching toward distant objects), as well as those that could not be consistently scored due to variation in subject orientation relative to camera (e.g., smiles). Asterisk (*) prior to code symbol indicates the event has duration, and thus is to be scored with a "+" at onset and again with a "-" at termination. Hardware employed in the videotaping and coding at the mother-infant videotapes is described in Report 1HOK01-1. Computer programs for the analysis of the coded data, along with some illustrative results are presented in Report 1HOK01-3.

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Coded Mother-Infant Video Tapes

	SESSION ORDER	AGE (weeks-days)	TREATMENT
DYAD A			
	1	12w-4d	Baseline
	2	14w-4d	Baseline
	3	15w-4d	Baseline
	4	17w-4d	Baseline
	5	19w-6d	No toys
	6	21w-4d	Baseline
	7	24w-4d	Mother ignores
	8	27w-5d	Baseline
	9	28w-3d	Mother ignores
	10	29w-2d	Baseline
	11	29w-4d	No toys, Mother ignores
	12	31w-3d	Baseline
	13	33w-3d	No toys
	14	34w-3d	Baseline
DYAD B			
	1	9w-4d	Baseline
	2	10w-4d	Baseline
	3	11w-4d	Baseline
	4	13w-1d	Baseline
	5	14w-4d	No toys
	6	16w-1d	Baseline
	7	17w-4d	Mother ignores
	8	18w-1d	Baseline
	9	18w-3d	No toys, Mother ignores
	11	24w-4d	Baseline
	12	26w-1d	Mother ignores
	13	26w-4d	Baseline
	14	27w-3d	No toys, Mother ignores
	15	28w-4d	Baseline
	16	29w-4d	No toys
	17	31w-4d	Baseline

NOTE: Session B-10 was not coded due to malfunctioning video equipment.

List of Objects

A	ball
B	mobile
C	clowns (2 different clowns - both hard)
D	infant or infant's body
E	mother or mother's body (including clothing, shoes)
F	pacifier
G	diaper
H	blanket
I	infant seat
J	infant seat belt
K	napkin, garbage pail
L	keys
M	paper bag, purse
N	bunny, elephant (both soft)
O	book
P	couch
Q	floor
R	table, cabinet, chair
S	magazine, newspaper
T	hammer (rattle)
U	coffee cup
V	musical toy
W	bottle
X	infant's shoe, shoe string
Y	microphone stand
Z	electric outlet, cord

NOTE: On following behavior code, objects are scored where indicated by blanks (.___).

Infant Code (I)

Visual Orientation

*I1.__Visual orientation toward a particular object
Note: 1) Identify Object.
2) Do not score (a) if uncertain about object of orientation or (b) if looking is less than 1 second duration.
3) Score continuously unless infant looks away more than 1 second (except when looking is interrupted by postural shift, as in code category M5P).

Physical Movement

I2A Lean forward or sit up (Include partially effective efforts to lean forward or sit up while restrained or otherwise incapable of completing the act. Score each time infant sits up again after he has returned to a relaxed position for 1 second.)

*I2B Roll (while the infant rolls over); if new location results, code I2F instead.

*I2C Crawl (while the infant crawls)

*I2D Stand (while the infant stands and remains in one position for more than 1 second)

*I2E Walk (while infant walks)

(NOTE: For future studies we recommend adding squirming and withdrawal from mother's touch.)

Object Exploration

*I3A__Active and passive manipulation (when the infant is touching, holding, or manipulating an object). Do not score (a) self contact except with his mouth, or (b) touching objects that are supporting him (e.g., mother, infant seat, blanket, table, floor). Score I3A (or I3B) continuously until I is no longer touching object.

*I3B__Object in mouth (when the infant puts an object in his mouth)

I3C__Kicking object (when the infant kicks an object for more than 1 second; object may be lying on his legs)

I3D__Dropping object (when the infant drops an object so that it is out of his reach)

Vocalization

*I4A Coo (pleasant sounding phonetic vocalization, in contrast to following categories)

*I4B Coo-irritated (resembles a coo phonetically, but with an irritated tone)

*I4E Grunt (straining sound - more staccato than fuss)

*I4F Fuss (relatively long intermittent wails)

*I4G Cry (continuous hard cry)

*I4H Giggle-laugh

Note:
1) Score vocalization as continuous if pause is not more than 1 second and the category does not change.
2) Score predominant category in a long vocalization if the different category is not longer than 1 second.
3) I4B vs. I4F: If borderline, score I4B.
4) I4G: Do not score any other infant category during his crying.
5) In future studies, we recommend addition of "scream".

Adaptors

I5A Sneeze

I5B Cough

I5C Yawn

I5D Hiccup

I5E Choke

Sleeping

*I6 Sleep (when the infant appears to be sleeping, with his eyes closed, or is drowsily immobile; doesn't include wide-eyed staring).

Loss of Postural Control

I7A Falling over--sitting-I (when the infant is sitting and falls over because of his own actions)

I7B Falling over--sitting-M (when the infant is sitting and falls over due to the mother's movements)

I7C Falling down--standing (when the infant is standing and falls down)

I7D Falling--hurts self (apparently)

Note: We recommend collapsing I7's for analysis.

Mother Code (M)

Visual Orientation to Infant

*M1A Visual orientation toward infant (the mother is looking at the infant and her eyes are within the infant's peripheral vision)

*M1B Visual orientation toward infant--unseen (when mother is looking at the infant and her eyes are not in the infant's peripheral vision)

Note: 1) Flicks less than 1 second not scored.
2) If unsure as to her direction of looking and the infant is in her line of orientation, score M1A.
3) If unsure if she is in the infant's peripheral vision, score M1B.

Stimulus Contr

*M3A.__Jiggles stimu

*M3B.__Jiggles stimulus with a part of infant's body

*M3C.__Moves stimulus closer, but not in infant's reach (if the infant were to extend his arm)

M3D.__Moves stimulus to within infant's reach (if the infant extended his arm)

M3E.__Moves stimulus to infant (where the infant has complete control of the stimulus and the mother has withdrawn her hand from the stimulus)

*M3F.__Moves stimulus away-within sight (where the mother moves the stimulus away from the infant and the infant is in a position where he can still see the stimulus)

*M3G.__Moves stimulus away-out of sight (where the mother moves the stimulus away from the infant and the infant is in a position where he cannot see the stimulus)

*M3H.__Picks up dropped stimulus and gives it back to the infant (when the infant has dropped a stimulus he has been engaging with to the floor, table, etc.)

*M3I.__Interrupts and restrains the infant's physical contact with an object (does not result in the infant losing the stimulus, only interference)

Note: 1) Always identify which stimulus she is controlling.
2) End scoring for durational categories when the mother's hand and/or arm have stopped either jiggling, interfering, or moving the stimulus closer or farther away.

3) M3A: If she inadvertently jiggles a stimulus while doing something else and the infant is in a position to see the jiggled stimulus, score M3A. If she is doing things like spreading out a blanket, unfolding a diaper, rustling through a paper bag, and the infant can see this activity, score this moving of a stimulus as M3A. If she claps her hands or uses her hand as a stimulus (points, claps, bangs) or uses feet in similar fashion, score M3A.
4) M3C vs. M3D: If unsure of the distance between the stimulus and the infant's reach, score M3C.
5) M3D - M3E: Score when she begins to bring the stimulus to the infant.

Vocalization

*M4A Arousing (animated quality of speech-beyond the normal conversational level, variation in pitch beyond normal range-variation typically is in an up direction or up-down and is smooth, loudness beyond normal; includes exaggerated baby talk)

*M4B Soothing (smoothly declining pitch, slow and drawn out, sympathetic content)

*M4C Negative (irritated tone, sharp, sudden, staccatto-like, may have descending pitch, threatening content)

*M4D Neutral (conversational-type voice, includes slightly animated whiney or resigned quality, can be supersoft)

*M4E Questioning (rising terminal pitch-ending,request-type content)

*M4F Whistle-click (whistling, clicking, hissing sounds)

*M4G Imitating (apparent copying of infant's preceding vocalization)

*M4H Singing

*M4I Nursery rhyme (a rhythmic, stylized nursery rhyme)

*M4J Laugh-chuckle (score even if it sounds like a pseudo laugh or chuckle)

Note: 1) Score continuous if pause is not more than 1 second and the category does not change.
2) Score predominant category in a long vocalization if the different category is not longer than 1 second.
3) Score M4D for borderline vocalizations.
4) Suffixes for M4
,1 = contains infant's name
,2 = directed toward other person than infant
5) For future study, we recommend adding whisper and mocking tone.

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Relocation of Infant

M5A Hold on lap-distant (infant sits on her lap and is closer to her knees than to her torso)

M5B Hold on lap-close (infant sits on her lap and is closer to her torso than to her knees)

M5C Hold in front (mother holds infant in front of her with her arms outstretched and the infant's feet are not supporting him)

M5D On torso-distant (mother holds infant next to her torso and their heads are close, but not touching)

M5E On torso-close (mother holds infant next to her torso and their heads are touching)

M5G. Standing (mother stands infant on an object)

M5H Carry-walking (mother walks while she is holding the infant)

M5I Carry-standing (mother is standing and holding the infant)

M5J Sits down (mother sits down after walking and/or standing and she is holding the infant)

M5K. Sitting (mother moves infant to a sitting position on an object other than herself)

M5L. Face up-lying (mother moves the infant to a face up-lying down position on an object other than herself)

M5M. Face down-lying (mother moves the infant to a face down-lying down position on an object other than herself)

*M5O Toward her (mother moves the infant toward her but does not pick him up)

*M5P General shift (mother rearranges and adjusts the infant's posture while she is holding him or he is positioned on something else that does not result in the infant being relocated to a new position)

Note: 1) A relocation is scored when (a) the mother's body adjustment results in a new position for the infant, (b) the infant moves by himself and a relocation category results, (c) the mother moves him and a new position results, or (d) if the new move results in the same position (for instance, if the mother stands him on the couch, and then moves him to another part of the couch, still standing, score the same position each time she moves him).

2) Onset is scored (a) when to move the infant, the mother has her hands under his armpits, (b) at the start of the action by which the mother or infant move themselves so that a new position results, (c) at the start of the action by which the mother starts to stand up, sits down, or stops walking and stands, or vice versa, or (d) at the start of her movement when the relocation category remains the same. For nondurational categories, time in new location is implied by time of onset of next location.

3) M5A-M5B: Includes mother or infant leaning forward or backward.
4) M5G, M5K, M5L, M5M: Identify which objects he is put on and/or into.
5) M5H: Score during any steps taken by the mother.
6) M5I: Score if standing lasts for more than 1 second; don't score if the mother is in the physical adjustment period of sitting down.
7) M5J: Score the infant's position after the mother has gotten seated.
8) M5P: Includes such acts as tipping the infant seat forward or backward. Don't score when M has moved I to new position and gets him settled.

Physical Contact

*M6A Touch (when the mother's hand is placed on a part of the infant and remains stationary for more than ½ second and is not there to support him)

*M6B Jiggle with hand (when the mother's hand somewhat roughly jiggles or shakes the infant)

*M6C Jiggle with body (when the mother somewhat roughly jiggles, shakes or bounces the infant with her body, e.g., bouncing him on her knees)

*M6D Rock (gently)

*M6E Pat/rub (gently)

*M6F Burp the infant

*M6G Tickle-pinch (with mother's hand)

*M6H. Tickle-pinch-other (with an object)

*M6I Stylized game (mother uses infant's limbs to play the game, e.g., "so big", "patty cake")

*M6J Ties shoes-brushes hair of infant

*M6K Support (mother's hands support the infant and he is not in positions M5A - M5J); score when 5G, except 5G.E.

*M6L Change diaper (when the mother changes the infant's diaper)

*M6M Hug

*M6N Pacifier (mother places a pacifier in the infant's mouth)

*M6O Wipe body (mother wipes the infant's mouth, face, hands, etc., with diaper, etc.)

*M6P Kiss-nuzzle (rough or soft)

*M6Q Pull and adjust clothing (mother tugs and pulls down the infant's clothing, apparently to adjust his clothing)

*M6R Remove restraint (mother removes an object that is restraining the infant, e.g., infant seat belt)

*M6S Restrain (mother restrains the infant's limbs or body movement, e.g., holding his arm down)

*M6T Feeding-duration (when bottle is placed in I's mouth, until it is removed)

Note: 1) Score onset at the start of the move that results in the physical contact.
2) Score all categories continuously unless a pause is more than 1 second.
3) M6H: Identify object used.
4) M6I: If M uses object in game, e.g., diaper in "peek-a-boo", identify object.

Spatial Relocation

*M7A Moves to infant-distant (when the mother moves closer to the infant to a position that requires or would require walking or crawling for contact)

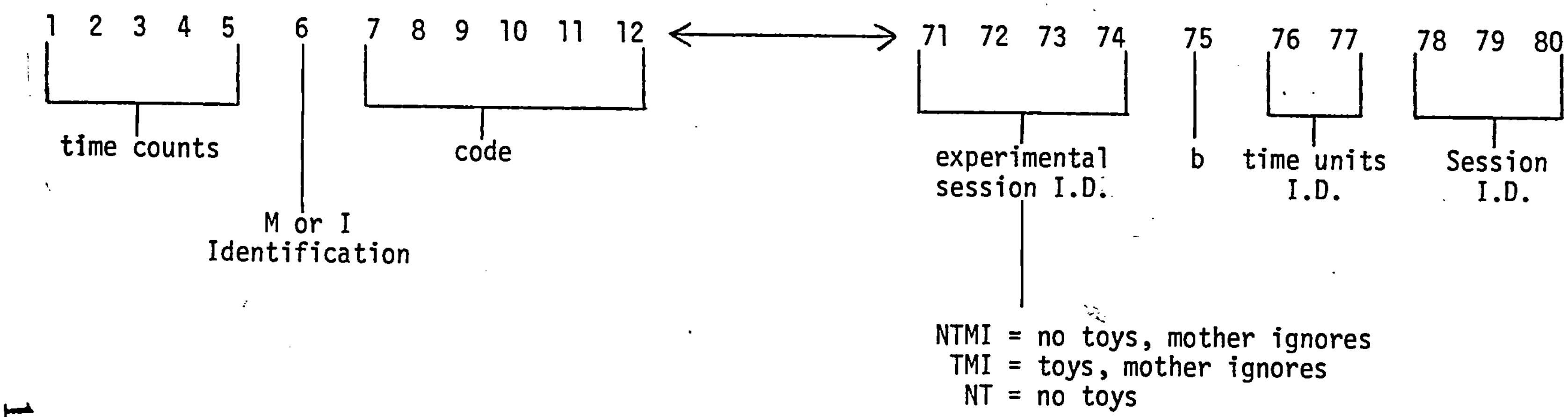
*M7B Moves to infant-close (when the mother moves closer to the infant to a distance where she is close enough to touch him with her arm outstretched)

*M7C Moves away-distant (when the mother moves away from the infant to a position that requires or would require walking or crawling for contact)

*M7D Moves away-close (when the mother moves away from the infant to a distance where she is close enough to touch him with her arm outstretched)

Note: 1) Score onset when she begins the move.
2) Score offset when she has stopped moving closer or away.
3) M7B + M7D: Don't score if infant is in positions M5A-M5J.
4) M7A + M7B: Don't score if move results in activity with the infant.

IBM CARD CODING FORMAT



COMPUTER ANALYSIS OF TIME-CODED MOTHER-INFANT INTERACTION

Howard M. Rosenfeld
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KANSAS CENTER FOR RESEARCH IN EARLY CHILDHOOD EDUCATION

Project Code 1HOK01-3
Development of Social Competence
December, 1972

COMPUTER ANALYSIS OF TIME-CODED MOTHER-INFANT INTERACTION

Project Director: Howard M. Rosenfeld
Programming Supervisor: Jeff Bangert
Programmers: Bill Maxwell, James Waldby

Introduction

The primary purpose of this project was to develop computer programs to aid in the rapid and efficient analysis of complex social interaction processes. Most of the programs to be described were developed in particular for processing data from the type of coding system described in Report 1HOK01-2 - data that are multivariate, binary, and time-series. The coded data consist in alpha-numeric symbols, hierarchically labeled, with each observed event tagged by time of onset and termination. The programs range in function from simple preparations of data for further computer analysis, to the analysis of distributional properties and temporal relationships of variables. Relatively heavy emphasis is placed on the detailed distributional analysis of elementary data categories on the assumption that little is known about the functional organization of infant social behavior (in relative contrast to adult behavior).

The present report lists programs that are being applied to data from the mother-infant study referred to in Report HOK01-2. The programs are in varying states of development, and are likely to be further revised as we obtain additional evidence of their contribution to our understanding of social interaction processes. Our aim is to organize them all in a standard FORTRAN format. Qualified investigators interested in the possibility of submitting their own coded data to the programs on an experimental basis should write to the project director. The current report also includes a brief description of an additional "automation" approach to the computer analysis of the mother-infant data, currently being developed in cooperation with members of the Electrical Engineering Department at the University of Kansas. Finally, some illustrations will be presented of substantive results of computer analyses that have already been applied to the mother-infant data.

Outline of Current Computer Programs

The programs listed below are categorized by their major functions in the present project, and in approximate sequential order of their usage. Those marked MBT (for "Multivariate Binary Time-series") were developed in conjunction with this project.

Data Preparation

UTILITY: a standard routine for transfering coded data from punched cards to magnetic tape (A); also supplies a count of the number of observations coded in each data set.

MBT06A: data sets from Tape A (above) are sorted by event time and written on a new tape (B) by event name, time, and on-off designation.

MBT12A: data sets from Tape B (above) are sorted by code category, with events in each category sequentially sorted by time of occurrence.

MBT07D: sequencing errors in coded data are detected and listed, and preliminary corrections are provided for four kinds of sequencing errors; also all symbols occurring in a set of data are listed to permit visual scanning for illegitimate symbols.

MBT09A: card files are manipulated on tape, including insertion, deletion, and replacement of cards.

MBT01G: translation of alpha-numeric code symbols to binary data.

Listing and plotting of data

MBT11A: coded events are listed by time of occurrence, with symbol and on-off designation.

(MBT12A): aforementioned sorting program, which also lists sequential events per code category, by symbol, time, and on-off designation.

SFA47E: multivariate code categories are plotted in parallel by time-series of event occurrences.

General Summarization of Event Frequency Distributions

MBT07D: listing of coded events by hierarchical tree structure of code, with frequency of observations, total time of occurrence, average duration of occurrence, mean time of occurrence and associated U statistic.

Univariate Time-Series Analysis of Event Categories

MBT14A: univariate Markov analysis--comparative N-way tests of the predictability of temporal on-off patterns of a code category by fixed elementary time units.

Univariate Time-Sequence Analysis of Event Categories

MBT17A: distributions of various temporal features of a code category over fixed elementary time units, such as off-on ("starts"), on-off ("stops"), off-on-off ("spikes"), and off-on-on ("real starts"); and transformation of time series to time sequence form.

MBT15B: determination of "break-points" in distribution of an event category over blocks of elementary time units, in terms in change of density of occurrence (Note: a possible basis for redefining what is a variable).

Multivariate Time-Series Analysis of Event Categories

MBT04B: Markov analysis of replicated patterns of events, over specified fixed-time periods and specified lengths of sequences of periods.

MBT05A: printout of multivariate transition matrices, in order of frequency of occurrence, along with first, last, and normative mean times of occurrence.

MBT05C: printout of multivariate transition lists (time of occurrence of each event in above patterns).

Multivariate Time-Sequence Analysis

MBT18A: histograms of adjacent event distributions, reflecting normalized temporal relationships between pairs of variables (as defined by above time-sequence analyses of individual event categories); also plot raw time sequence data and calculate statistics measuring amount and pattern of adjacent influence.

SFA52C: clustering of above histograms.

Nonsequential Multivariate Analysis

MBT16A: simultaneous occurrence of pairs of variables over specified fixed-time units, with corrected Chi Square values.

SFA01E: cosines of angle between all possible pairs of binary time series variables.

SFA03E: application of principal components factor analysis, for large data sets, to cosine matrix.

Development of an Automation Approach

In addition to applications of the preceding programs, the computer analysis of mother-infant interaction is being approached from an automation viewpoint. Members of the Department of Electrical Engineering at the University of Kansas are developing computer programs that will combine concepts and procedures for pattern recognition and systems control, thereby to provide a model of the mother-infant relationship from our time-coded data. The automation approach models the mother and infant each in terms of a finite set of multivariate states. While in any one of these states, the mother or infant can receive an input from the other person, causing both a change in the receiver's state, and the generation of an output by the receiver. This output, in turn, serves as the input to the other person. Through this process of reciprocal influence, a matrix of state transitions can be constructed.

A variety of processing steps are necessary to construct the model from the sequential binary data coded from our videotapes. The time-series details of the data must be reduced to sets of sequential states. Thus, absolutely-timed elementary units of behavior must be translated into ordinal events, primarily by removing temporally redundant measurement vectors. The mother and infant states also must be reduced to a reasonably small number of classes via a clustering process. Finally the automation resulting from the input-output strings must be decomposed to provide a reasonably understandable model.

Some Results of Computer Applications

Distributions of Binary Data

An extremely large number of elementary event categories were coded from the videotapes of the two mother-infant dyads, as is evident from the empirically-derived coding system. The distributions of these categories over time varied widely along such dimensions as frequency of starts and duration, pattern of temporal distribution, and consistency of distribution over time. These distributional properties, both within and between sessions, have important implications for the kinds of analysis to which the data can be submitted. Thus much of our initial effort has been directed toward a detailed description of distributional characteristics.

Computer analysis is essential as an aid to human interpretation of complex multivariate distributions. This need is evident in Figure 1 which contains a computer-generated plotting of a small number of "tracks" within a brief time period of the first session of Mother-Infant Dyad A. The Markovian distributions of individual tracks frequently proved to be extremely complex, and thus we have been emphasizing other approaches. One helpful approach to identifying variables that can be studied for interpersonal functions has been to search for variables that do not occur at excessively high or low rates and which are not too closely bunched together. In this program, the distribution of adjacent temporal time units for a given event category is inspected separately for "starts" (off-on-on pattern), "stops" (on-off-off), and "spikes" (off-on-off). Some results from the first session of Dyad A are illustrated in Table 1.

Insert Figure 1 and Table 1
about here

From a more macroscopic perspective toward mother-infant interaction, it is important to identify variables that are reasonably well distributed across sessions. From a social learning viewpoint, it is particularly important to discover variables that increase or decrease in rate of occurrence over time, so that different trends can be related to differences in social contingencies. Figures 2 and 3 illustrate some infant behaviors that increased and some that decreased for both of the dyads over nonexperimental (baseline) sessions. (The locomotion category illustrated is a combination

Figure 1

Example of computer plot of a subset of variables
from Session 1 of Dyad A

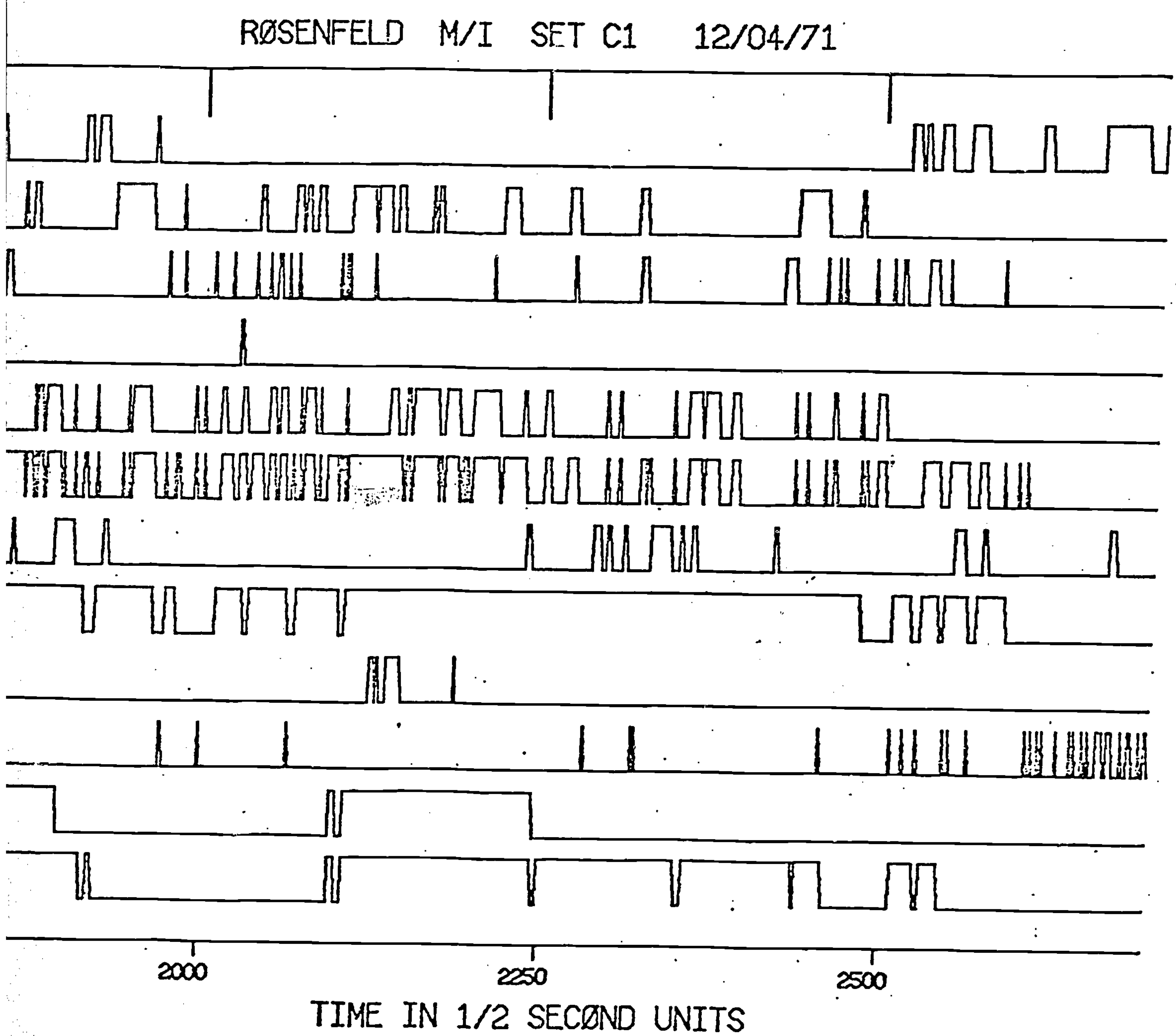


Table 1: Examples of computer selection of events meeting distributional requirements in Session 1 of Dyad A

RECORD OF CREATION OF TIME SEQUENCES
ROSENFELD M/I SET C1 01/23/73

INPUT VAR LABEL	FEAT NO	SEQUENCE LENGTH	OUTPUT VAR	PLOT NO	SEQUENCE	(OR DELETE)	
		CONT. OF	13		1517.1	1522.7	1529.5
					1761.3	1779.4	1788.5
					2405.6	2448.1	2456.6
16 M3A,B	2	37	14	47	401.2	418.2	536.7
					1519.9	1523.9	1530.7
					1751.9	1781.7	1790.2
					2409.0	2452.7	2461.2
16 M3A,B	3	2		48	NOT RARE EVENTS -- TOO FEW		
17 MCLOSR	1	18	15	49	427.9	555.4	735.0
					1752.2	1891.1	1913.2
17 MCLOSR	2	18	16	50	428.4	556.5	736.7
					1755.1	1892.8	1917.1
17 MCLOSR	3	12	17	51	1372.0	1487.0	1500.1
					2605.1	2687.3	
18 MFRTHR	1	28	18	52	439.6	521.7	1143.6
					1659.9	1671.2	1682.5
					2341.0	2380.1	2409.6
18 MFRTHR	2	28	19	53	440.3	623.4	1144.7
					1662.1	1675.2	1683.1
					2341.6	2381.8	2410.7
18 MFRTHR	3	0		54	NOT RARE EVENTS -- TOO FEW		
19 M4A	1	47		55	POINTS IN SEQUENCE TOO CLOS		
19 M4A	2	47		56	POINTS IN SEQUENCE TOO CLOS		
19 M4A	3	7		57	POINTS IN SEQUENCE TOO CLOS		
20 M4B	1	16	20	58	1278.5	1330.6	1342.5
					1973.8	1977.8	1983.4
20 M4B	2	16		59	POINTS IN SEQUENCE TOO CLOS		
20 M4B	3	0		60	NOT RARE EVENTS -- TOO FEW		
21 M4D	1	16	21	61	437.5	1302.8	1340.8
					1966.3	1993.7	2106.4
21 M4D	2	16	22	62	438.1	1304.0	1341.4
					1991.4	2012.4	2107.6
21 M4D	3	13	23	63	1166.3	1294.3	1319.3
					2384.1	2410.7	2706.6
22 M4[illegible]	1	77		64	POINTS IN SEQUENCE TOO CLOS		

of all locomotor events from the scoring system, and the object manipulation category combines varieties of objects and types of manipulations.) These distributions were derived from the program for determining the percentage of time units per session in which the activity was occurring, with the size of time unit set at one second.

Insert Figures 2 and 3
about here

By comparing the infant's behavioral trends over nonexperimental sessions to their rates of occurrence in interspersed experimental sessions, we provided immediate evidence of the degree to which the trend could be interpreted as a natural maturational progression, rather than an unexpressed ability of the child. In Figure 4, for example, it is clear that Infant A was capable of moving himself prior to starting such a trend in his seventh nonexperimental session (Session 10, age 29 weeks); in the first experimental session (Session 5, age 20 weeks), where toys were removed from the setting, the infant engaged in moving to new locations over 25 percent of the time!

Insert Figure 4
about here

Temporal Relationships Between Variables

We are applying three kinds of approaches to the analysis of temporal relationships between variables (particularly between infant and mother variables). While developing the computer programs previously described

Figure 2

Examples of infant behaviors the increased over nonexperimental sessions

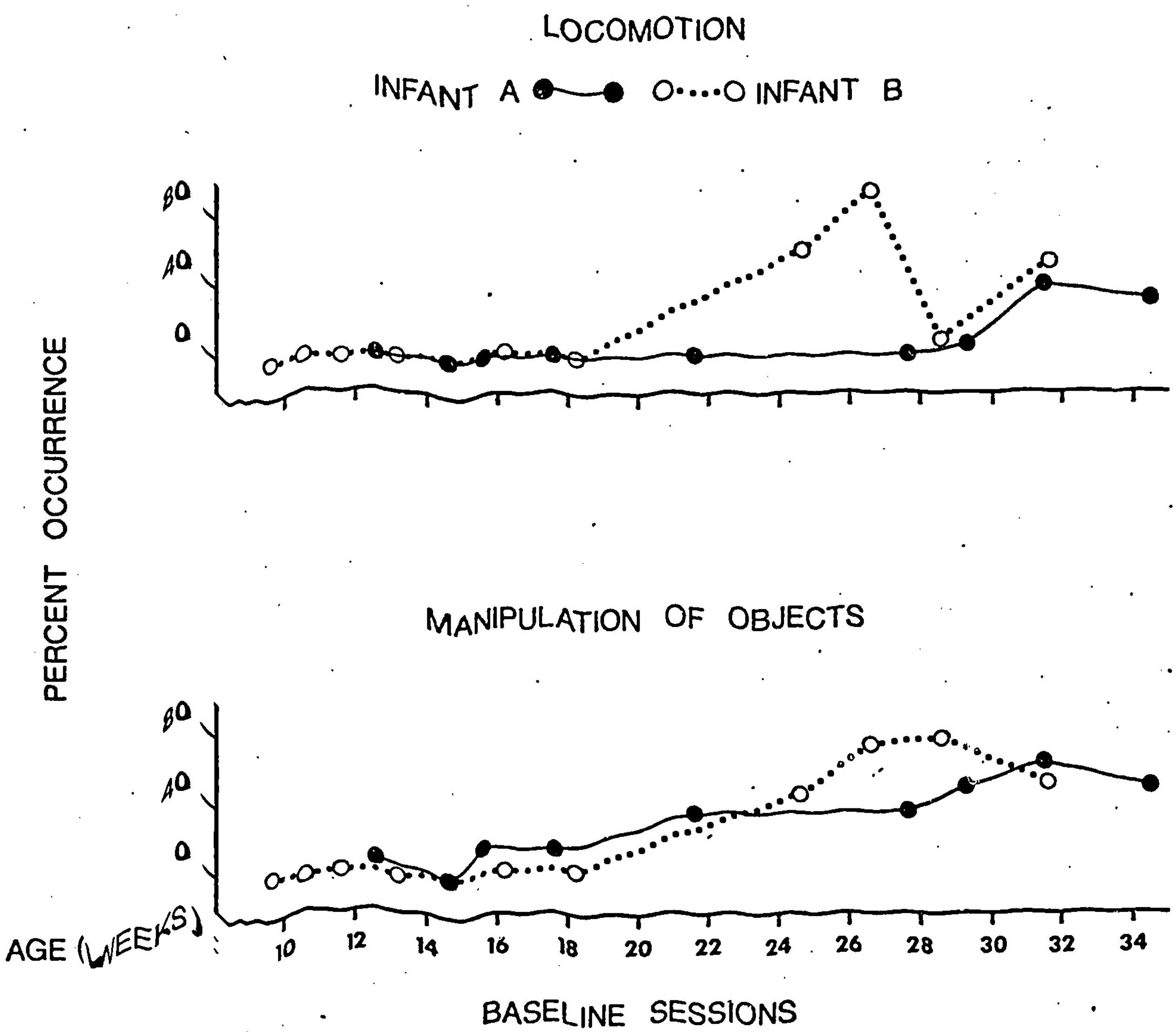


Figure 3

Examples of infant behaviors that decreased over nonexperimental sessions

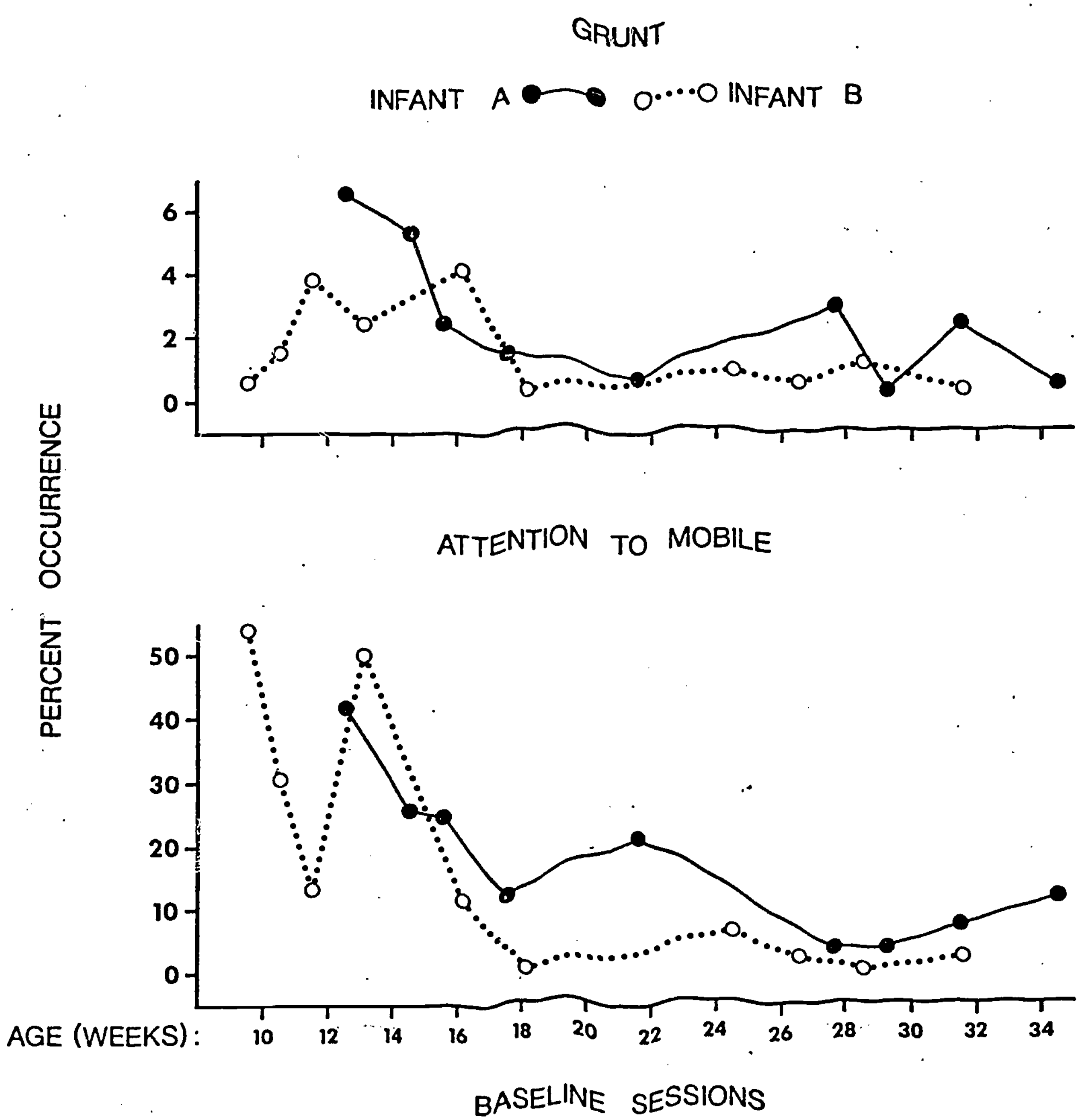
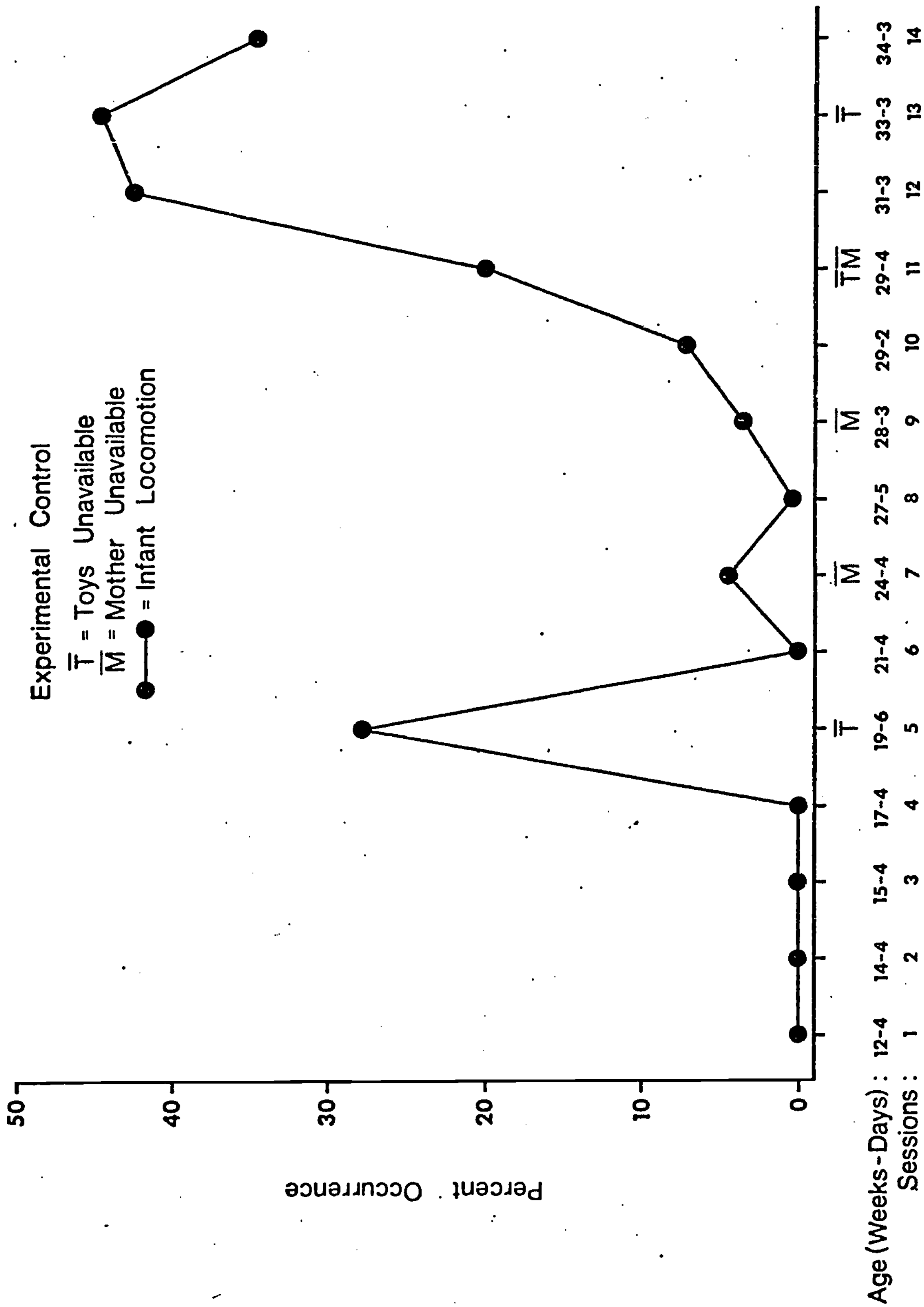


Figure 4

Effects of unavailability of toys and mother's attention on Infant A's mobility



in this report, a quasi-temporal analysis of maternal elicitors of infant fussing and crying throughout the study was carried out by Gail Browne. Separate periods of relatively persistent infant crying were identified throughout the data. Maternal events in the 25 seconds prior to each cry period were compared to those in randomly selected non-cry periods (random noncry) and to events in the second 25 seconds before crying (yoked noncry period). An existing computer program was applied (MAID, an adaptation by M. Gillo at the University of Kansas of the AID or Automatic Interaction Detection program of Sonquist and Morgan at the University of Michigan). This program searches for the levels of a set of predictor variables which combine to best account for variance in a dependent variable. The two infants differed considerably in configurations of maternal variables that differentially preceded crying. However, for both infants low levels of stimulation preceded crying, while a wide variety of stimulation preceded periods of apparent contentment. While the tree diagrams illustrating optimal combinations of predictors are too complicated to include in the present report, Tables 2 and 3 list the variance in crying accounted for by a set of individual maternal variables in Dyads A and B. The comprehensive programs being developed in the present project are expected to provide more precise evidence of the temporal structures and interpersonal functions of predictors generated by more traditional, nonsequential programs.

Insert Tables 2 and 3
about here

Table 2

Amount of Variance Explained by each Split Variable for Random vs. Precry and Yoked Noncry vs. Precry Segments for Mother A

Variable	Percent Variance Explained	
	Random Noncry	Yoked Noncry
Removes Stimulus	16.0	12.1
Age	6.2	5.2
Passive Stimulus	5.3	4.7
Vocalizes	3.0	9.2
Gentle Tactile Stimulation	1.7	1.2
Relocates	1.6	0.0
Holds	1.1	1.5
Variety of Stimulation	1.0	6.4
Visual Stimulation (I)	0.0	5.3
Total Variance Explained	35.9	45.6

Table 3

Amount of Variance Explained by each Split Variable for Random vs. Precry and Yoked Noncry vs. Precry Segments for Mother B

Variable	Percent Variance Explained	
	Random Noncry	Yoked Noncry
Age	7.2	0.0
Variety of Stimulation	5.1	3.9
Vocalizes	3.6	4.5
Passive Stimulus	3.5	0.0
Visual Stimulation (H)	1.3	2.5
Removes Stimulus	2.7	2.0
Relocates	0.0	1.8
Total Variance Explained	23.4	14.7

Our current applications involve both time-series and time-sequence procedures, the former referring to sequential relationships of more molar sequential events that may vary in real-time properties. At the time-series level we are analyzing the entire array of coded data for multivariate transition states. The data have been subclassified into 28 variables for this purpose, listed in Table 4 (the variables are defined in Report 1HOK01-2). The program can be set to determine the occurrence of variables within time-units of any specified size, and to list combinations of variables over any specified sequential number of time-units. Table 5 illustrates multivariate states from the first session of Dyad A.

Insert Tables 4 and 5
about here

For the study of time sequences, we are segmenting individual variables into temporal periods in terms of changes in rates of occurrence. (One could conceive of different rates of occurrence of the same coded variable as indicating a set of different variables.) In addition, variables having well spaced and non-extreme distributions, as described earlier, are being tested for temporal relationship to each other by means of the new "histogram" program. Examples of pairs of associated variables are shown in Table 6. (Nonassociation would be reflected by a flat distribution; in the illustration shown, the one-sided slopes indicate that one variable tends to follow the other.) A revised version of the histogram program will check for the effects of differential rates of occurrence of the same variable on its relationship to other variables, thereby providing the advantages of both time-series and time-sequence.

Table 4

Twenty-eight variables selected
for time-series analysis

1) I1.E (look at mother)	15) M1 (look at infant
2) I1.D, .X (look at self)	15) M3A, B (activate stimulus)
3) I1.B (look at mobile)	17) M3C-E, H; M7A, B (stimulus closer)
4) I1.A, .C, .L, .N, .T, .V (look at toys)	18) M3F, G; M7C, D (stimulus farther)
5) I1.Y, .Z (look at untouchables)	19) M4A (voice arousing)
6) I1.F-K, .M, .O, .S, .U, .W (look at other objects)	20) M4B (voice soothing)
7) I2A (lean-reach)	21) M4D (voice neutral)
8) I2B-F (relocate)	22) M4E (voice questioning)
9) I3A (handle objects)	23) M4F-J (voice strange)
10) I3B (mouth objects)	24) M5 (relocate infant)
11) I3D, I5, I7 (misc. problems)	25) M6B, C, G, H, I (rough stimulation)
12) I4A, H (voice positive)	26) M6A, D, E, K, M, P (gentle stimulation)
13) I4B, E (voice ambiguous)	27) M6F, J, L, N, O, Q, T (caretaking)
14) I4F, G (voice negative)	28) M3I; M4C; M6S; M6U (interference)

Table 5

Examples of multivariate transitional states in Session 1 of Dyad A

```
MULTIVARIATE MARKOV ANALYSIS
LIST OF 'ON' VARIABLES FOR  3-WAY TRANSITION STATES ON 28 VARIABLE

ROSENFELD M/I SET C1  COLLAPSING TO 1 SEC.

ROWS ARE THE TIMES.  ENTRIES IN THE ROWS ARE THE 'ON' VARIABLES.


NO.        1           COUNT    389       NO.        2            COUNT    95
MTIME       763.7       NMT   0.164       MTIME       2181.9        NMT   0.791
FIRST    278.0        LAST   1256.0       FIRST   1288.0          LAST   2520.0
COX'S U -19.433                           COX'S U     9.485

1.   I1.B                                 1.   I1.E    ,M1       ,M4E
2.   I1.B                                 2.   I1.E    ,M1       ,M4E
3.   I1.B                                 3.   I1.E    ,M1       ,M4E


NO.        4           COUNT     35       NO.        5            COUNT    31
MTIME       627.7       NMT   0.157       MTIME        947.2        NMT   0.286
FIRST    393.0        LAST   1179.0       FIRST     247.0         LAST   2195.0
COX'S U   -6.937                          COX'S U   -4.078

1.   I1.B    ,I4A,H                       1.   M1
2.   I1.B    ,I4A,H                       2.   M1
3.   I1.B    ,I4A,H                       3.   M1


NO.        7           COUNT     25       NO.        8            COUNT    24
MTIME       936.9       NMT   0.282       MTIME       1675.9        NMT   0.579
FIRST    304.0        LAST   1253.0       FIRST   1502.0          LAST   1878.0
COX'S U   -3.734                          COX'S U     1.329

1.   I1.B                                 1.   I1TOYS,I3A    ,M1
2.   I1.B                                 2.   I1TOYS,I3A    ,M1
3.   I1.B    ,I4B,E                       3.   I1TOYS,I3A    ,M1


NO.       10           COUNT     20       NO.       11            COUNT    20
MTIME       990.2       NMT   0.304       MTIME       1828.6        NMT   0.640
FIRST    325.0        LAST   1255.0       FIRST     242.0         LAST   2241.0
COX'S U   -3.011                          COX'S U     2.153

1.   I1.B    ,I4B,E                       1.   M1       ,M4E
2.   I1.B                                 2.   M1       ,M4E
3.   I1.B                                 3.   M1       ,M4E
```

Insert Table 6
about here

Further substantive results will be presented by the project director at the Biennial Meeting of the Society for Research in Child Development in Philadelphia, March 31 - April 4, 1973, in a Symposium presentation entitled "Time-Series Analysis of Mother-Infant Interaction."

Table 6

Examples of histograms showing relationships between pairs of variables in Session 1 of Dyad A

```
HISTOGRAM NO.    69              SEQ   7  WITHIN   SEQ   8
              0
              0
              0
              0
              0
              1 *
              0
              5 *****
              3 ***
             12 ************
FOR 21 INTERVALS IN SEQUENCE  8, MEAN INT, LENGTH =    84,87     STD, DEV, INT
POINTS IN SEQUENCE   7 =  21       POINTS OCCURRING SIMULTANEOUSLY IN BOTH SEQUE

HISTOGRAM NO.    70              SEQ   9  WITHIN   SEQ   6
              7 *******
              8 ********
              1 *
              1 *
              1 *
              1 *
              1 *
              2 **
              0
              1 *
FOR  4 INTERVALS IN SEQUENCE  8, MEAN INT, LENGTH =   147,50     STD, DEV, INT
POINTS IN SEQUENCE   9 =  23       POINTS OCCURRING SIMULTANEOUSLY IN BOTH SEQUE

HISTOGRAM NO.    71              SEQ  10  WITHIN   SEQ   8
              1 *
              2 **
              1 *
              1 *
              1 *
              1 *
              1 *
              4 ****
              1 *
              0
FOR  6 INTERVALS IN SEQUENCE  8, MEAN INT, LENGTH =   157,55     STD, DEV, INT
POINTS IN SEQUENCE  10 =  13       POINTS OCCURRING SIMULTANEOUSLY IN BOTH SEQUE
```

FY 1972

December, 1972

Project:	Attentional Processes and Cognitive Styles in Toddlers and Preschoolers
Project Code No.:	3HOK03
Principal Investigator:	John C. Wright
Contents of this report:	Overview of the Project
	K03-3 Introduction
	K03-6 Users' Manual for the KRISP
	K03-3 K03-7 The KRISP: A Technical Report K03-8
	K03-5 Salience of Dimensional Cues and Attentional Set in Children's Color-Form Matching
	K03-4 Habituation of Concept Stimuli in Toddlers

Note: Two additional sections, referred to in the Overview, are to be submitted as a progress report due February 28, 1973. They are:

1. Five experimental studies in progress.
2. Four studies in planning.

ATTENTION AND COGNITIVE STYLES

John C. Wright

Principal Investigator

I. Overview

The project on Attentional Processes and Cognitive Styles in Young Children's Learning has concentrated during the past year on the development of a cognitive style assessment instrument for three- to eight-year-olds and on a series of studies designed to evaluate the role of stylistic and attentional processes in the development of various cognitive competencies in young children.

The Kansas Reflection-Impulsivity Scale for Preschoolers, or "KRISP" (Wright, 1971) was initially developed as a research instrument for use with children younger than can be effectively tested by the matching Familiar Figures test (MFF) developed by Kagan (1966). In the past year some preliminary norms have been established, resulting in a manual for users which now makes the KRISP useable by untrained personnel. (Section 3, below). In addition to the manual, this report incorporates a technical report on the KRISP for other researchers, including inter-form, test-retest, and intertester reliabilities, age and sex differences, a one-year stability study, and a study of retardate performance on the KRISP. (Section 4, below).

The fifth section of this report contains two completed studies of attending behavior in young children. The first, on the role of salience and decentration in the development of color-form preferences (Wright, Embry, and Vlietstra) shows how the progressive decentration of attention with increasing age, combined with salience, locus, and sequence of cues, accounts for what has been claimed to be a maturationally governed shift of preference from color cues in younger children to form cues in older one. The second completed study, habituation of concept stimuli in toddlers (Faulkender & Wright), demonstrated a new method for the assessment of "protoconcepts" in three-year-olds, children too young to perform effectively on the kinds of verbal-conceptual tasks customarily employed with preschoolers, but old enough to demonstrate not only their possession and use of simple preverbal concepts, but also differential patterns of individually characteristic observing behavior that may bridge the gap between the differential habituation observed in infants (Horowitz, 1972) and the reflection-impulsivity styles assessed by the KRISP in older preschoolers. Because the new Faulkender & Wright procedure is based on the "iconic" level of representation and the sensorimotor level of thinking, it promises to be generally useful for future research in the neglected age range of from eighteen months to four years.

The sixth section of this report describes five studies in progress, all aimed at elucidating the development of attention or observing strategies as preverbal aids to young children's learning. Four of these studies are concerned in part with the interaction of saliency of cues, observing response bias or strategy, and relevency or informativeness of cues with the subject variables of age and/or reflection-impulsivity as determinants of children's cognitive performance. Two of the studies are concerned with memory, one with habituation and dishabituation of looking behavior, one with homologous comparison strategies in a same-different task, and one with a more conventional discrimination, but in the haptic modality.

Finally a seventh section describes four studies in the planning stages all designed to extend the findings of this program in various ways. One will test the validity of the KRISP in relation to a number of free-play observation variables, scores on other standardized tests, and motor skills. Another will begin a three-year longitudinal study of cognitive style differences using a population of toddlers on which Horowitz has previously recorded infant attending data and Brazelton (Neonatal assessment scale) scores. A third study investigates the effects of relevance of salient cues on performance in an eye-hand coordination task. A final study attempts to relate the differing formal or structural properties of children's television programs (Sesame Street and Mister Rogers' Neighborhood) to reflective and impulsive children's attending behavior in the presence of these programs.

During the past year several changes in funding and administration have hampered progress to some extent, but the shift of administration from USOE and CEMREL to NIE, effective March 1, 1973, and the restructuring of long term funding under a new Basic Program Plan, effective December 1, 1973, promise to expedite our progress in the current and future years. The new BPP will combine this research project with the Infant project directed by Professor Horowitz into a single, integrated program; and this change also promises to facilitate operations next year.

Progress on this project would have been impossible without the skilled administrative assistance of Ann Branden. Non-student supporting personnel include Melody Johnson, Steve Whittenberger, and Judy Larson. Graduate assistants employed on the project include Alice Vlietstra, Kenneth Shirley, Pat (Faulkender) Keaton, and D.J. Gaughan. Other graduate students with major involvement in the program include Kathleen McCluskey, Russ McClanahan, and Joanne Ramberg. Among the many undergraduate students who have assisted on this project during the past year, those taking major research responsibilities were Charles Herrick, Lynne Embry, Janet Winchester, Teddy Jackson, April Waldron, and Ted Schlechter. The Director records his appreciation of the contributions of all of these persons and the cooperation of numerous school, hospital, and daycare administrators, teachers, and parents. Perhaps the biggest debt is owed to the children who diligently, patiently, and cheerfully played our games with us.

Introduction

A critical gap in our knowledge base concerning the development of cognitive competence and learning abilities exists between the ages of about two and five years. In particular, theoretical conceptions and teaching methodologies for use in this age range have been inadequate for the needs of the toddler and younger preschooler. This program of research has identified a number of points of departure for planned intervention that are promising in terms of what is known about pre-operational thought (Piaget) and iconic representation (Bruner), but which require supplementation of the knowledge base, invention of new training procedures, and special attention to individual differences in styles of information processing.

Specifically this program has been developing, field-testing, and norming a cognitive style instrument, the Kansas Reflection-Impulsivity Scale for Preschoolers (KRISP) (Wright, 1971), together with a manual for teacher-users (Wright, in press) that will enable early childhood workers in various settings to identify outstandingly reflective or impulsive childre and to make corresponding individual diagnoses of the kinds of learning situations and tasks in which future learning problems may be anticipated. The second body of work is basic research on information-intake processes and attentional skills needed for adequate learning and development of cognitive competence in toddlers and young preschoolers. Our studies of the relationship of attentional strategies to effective discrimination learning and matching performance utilize age, sex, and reflection-impulsivity as independent subject variables, together with modeling, fading, and shaping procedures as independent experimental variables designed to build those repertoires of attending, visual analysis, scanning strategies, and the like that are needed for effective learning and memory. Thus both treatment and subject variables go into the experimental designs and are used to qualify the results. Furthermore, the dependent variables include effectiveness of observing and attending behaviors as well as rate and accuracy of correct responding. By the end of the program, some three or four years from now, we expect to have completed procedures for remediating extremes on the reflection-impulsivity dimension in those settings and tasks where difficulties may be confidently anticipated.

The outcomes programmed in order of their immediate availability for field testing and general use are thus: 1) the KRISP and associated user documents; 2) basic research on attentional processes in young children's learning to supplement the knowledge base selectively in those areas where it is both deficient and promising as a point of departure for intervention studies; and 3) training procedures for modification of style-related behaviors toward those demonstrated as being prerequisites for effective learning.

Children of equal intellectual ability often differ radically in the style with which they approach and solve problems. This is especially so in the many sorts of problems where early discrimination of relevant from irrelevant cues and consequent effective attention deployment are critical to solution. In particular, with tasks in which speed and accuracy (or attention to detail) are negatively related, about one-third of any sample of children are characteristically fast, but error-prone ("impulsive"), while another third are slower, but more accurate ("reflective") than the remaining average third of the group. Educators and psychologists have long been aware of these stable, generalized, and hard-to-modify individual differences among children, and recently a number of investigators have demonstrated both the generality and the developmental primacy of such differences (Kagan, 1963, 1964a, 1964b, 1965a, 1965b, 1965c, 1966a, 1966b, 1966c; Messer, 1970; Harrison & Nadelman, 1972; Massari & Schack, 1972; Reali & Hall, 1970; White, 1971; Katz, 1971; Odom, McIntyre & Neale, 1971; Loo & Wenar, 1971; Eska & Black, 1971).

The first effort in this program has been concerned with the completion of the Kansas Reflection-Impulsivity Scale for Children (KRISP) (Wright, 1971 together with a testing and scoring manual (in press) that will enable teacher and child-care specialist users to assess reflection-impulsivity in young children simply, accurately and reliably. The KRISP is also being tried out on samples of retarded children of a mental age comparable to the normal toddlers and preschoolers in order to determine whether they too show cognitive style differences that might constitute a source of interference with effective learning. Preliminary data indicate that degree of retardation has smaller effects on KRISP scores than does institutionalization (Wright, Segler, & Ramberg, in preparation). Assessment of the long-term reliability of the KRISP over a one-year span has begun, and a series of validation studies are being planned to relate the KRISP to the Bender Gestalt Test, sensorimotor coordination, and attention span vs distractability in free play settings.

One key to the effects of reflection-impulsivity upon cognitive development appears to lie in the demonstrated importance of patterns of attending behavior as determinants of information processing, especially in young children. Prior to the age of six or seven years, when verbal and concrete operational skills begin to mediate learning and thinking effectively, recent evidence has shown that conditions favoring selective attention to relevant and informative features of a task are especially helpful (Gaines, 1970; Nodine & Lang, 1971; Odom & Mumbauer, 1971; Odom & Guzman, 1972; Witte & Grossman, 1971; Lehman, 1972; Yussen, 1972; Wright, Emby & Vlietstra, 1972; Wright, 1972a). At the same time it has begun to be apparent that reflection-impulsivity as a cognitive style is related to visual analysis skills, and especially to effectiveness of search strategies and patterns of attention deployment (Drake, 1970; Siegelman, 1969; Zelnicker, Jeffrey, Ault, & Parson, 1972; Adams, 1972; McCluskey & Wright, in preparation). Viewed developmentally it appears that the child between two and five years explores his environment at first as a function of what is novel, salient, inherently interesting, or associated with past rewards, but not in any task-relevant or systematic way. Later in this interval, however, if conditions are favorable, the control of the child's attending behavior begins to shift to the logical requirements of the task at hand. An exploratory pattern is eventually replaced by a deliberate search pattern. Curiosity is supplemented by relevance considerations. Play gives way to a work orientation when the task at hand is understood and within the child's competence. A consummatory orientation toward task stimuli begins to be displaced by an instrumental orientation as looking behavior comes under the control of somewhat longer range goals (Hutt, 1970; Ruble & Nakamura, 1972; Sellers, Klein, Kagan, & Minton, 1972; Turnure, 1971; Wright & Vlietstra, in preparation; Wright, Embry, Winchester & Jackson, in preparation; Wright, Embry & Vlietstra, 1972).

Moreover, both skills and strategies associated with selective attention and the stylistic preferences referred to as reflection-impulsivity appear to be at least partly and temporarily (and maybe selectively) modifiable under experimental conditions (Briggs, 1966; Nelson, 1968; Yando & Kagan, 1968; Kagan, 1966d; Debus, 1970, 1972; Denney, 1972a, 1972b; Heider, 1971; Ridberg, Parke, and Hetherington, 1971).

Our thinking and research to date has therefore been focused on the ways in which young children learn selectively to attend to different sources of stimulation in the environment, these sources being distinguished by sensory modality, physical locus, salience factors, and logical priority. Under this heading, "attentional processes in learning", previous research with school age and preschool age children is being extended downward to the preschool and toddler levels. Concurrently certain systematic findings on attention in infants have resulted from procedures that appear to be extendable upward for use with toddlers, such as habituation (or response decrement) and recovery (dishabituation). We have begun utilizing these procedures in studies designed to assess and modify toddlers' "protoconcepts" as manifested by selective generalization of induced habituation (Faulkender & Wright, 1972).

Under the heading, "attentional processes in learning", we have addressed ourselves to the following basic research questions, both because they appear to be important, promising points of departure for effective intervention to enhance the development of cognitive competence and because it appears from the existing knowledge base that they are now becoming answerable questions: a) How do children acquire and flexibly generalize routines for finding informative cues and for discriminating relevant from irrelevant information sources from visual, tactual, and auditory arrays of stimuli? b) What experiences contribute to a transition from primarily stimulus controlled, salience-oriented exploration to subject-controlled, task-oriented search? c) Can scanning strategies and search routines be specified in sufficient detail and generality so as to make them communicable to children as young as two to five years of age? d) As a function of age and cognitive style, what methods are most effective for this training?

e) Once acquired, whether by specific training or by unstructured experiences in a comparably enriched learning environment, how broadly can such routines be generalized? That is, can the child apply them widely and flexibly to entirely different problems that nevertheless have the same formal and logical properties as those on which the routines were originally established? And finally, (f) How enduring are such routines or strategies -- how long are they retained without further prompting or training?

The answers to the above questions should enable us to attack more directly the question of cognitive handicaps associated with extremes of reflection-impulsivity. That is, on the basis of an improved understanding of the age changes in attending and observing behaviors and their relation to children's learning, we propose that it should be possible to train impulsive children at an early age to use certain more reflective, careful, thoughtful, and deliberate methods of apprcaching learning and problem-solving tasks. Thus our long-range orientation is toward early identification of extreme impulsivity (and in some cases reflectivity) together with development of remediation techniques for training effective, task-oriented search routines in children whose lack of such skills promises subsequent learning difficulties in more formal educational settings.

Objectives of Program

The long range objective is to be able to put into the hands of teachers and child-care workers a set of assessment instruments, training procedures, and facts about the development of attending skills in children of different ages and cognitive styles that will enable them to identify potential attentionally based learning problems early and to begin remediation of them differentially as a function of age and style.

In order to achieve this objective, it is necessary to complete norming of the KRISP on a large population of toddlers and preschoolers. First-generation norms are now in hand. The second generation will be based on considerably larger numbers of children, and may need to be stratified in terms such as urban vs. non-urban, socioeconomic status, as well as age, sex, and number of previous administrations of the scale. Inter-form, scorer, and test-retest reliability figures need again to be assessed with each new contributing population.

A second intermediate goal is to determine the accuracy and utility of our current theoretical model describing the processes involved in the developmental transition of observing behavior determinants that allegedly takes place in the years from age two to five. This is being accomplished by a series of experiments designed to compare trained vs. untrained, younger vs. older and reflective vs. impulsive children, on indices of systematic stimulus scanning and effective discrimination learning and memory Among the training variables are included modeling and fading techniques, stimulus class habituation and dishabituation procedures, and the systematic manipulation of the salience of relevant and irrelevant stimulus features.

The third intermediate goal corresponds to the third research effort and forms a bridge between the first two. It is the modification of extreme and maladaptive cognitive styles in selected tasks by means of training in those attention deployment skills that appear from the studies described in the preceding paragraph to be both trainable and important for learning and memory tasks. This style training will be aimed not at reducing the range of reflection-impulsivity in any group of children, but rather at teaching children to discriminate those tasks requiring a more reflective approach from those that benefit from a more impulsive orientation, and to adopt the appropriate style for the task at hand. It is obvious that impulsive children have difficulties with tasks requiring careful analysis and convergent thinking directed toward a single "right" answer. Not so obvious is the possibility that reflective children are conversely handicapped when it comes to free expression in creative art, body-movement, story-telling, and other learning situations requiring divergent thinking and a high rate of relatively uncritical behavioral output.

These basic questions in a context of current research on attentional and stylistic differences in cognitive development serve to focus our concerns on the more applied issues of how to identify stable individual differences early and how to develop both stimulus materials and training programs that will demonstrably, reliably, and economically facilitate effective attending and learning for unique children in the stylistically and developmentally heterogeneous target population. We cannot expect what is most effective for three-year-old impulsive children to work as well with five-year-old reflectives. But we can expect this program of research to lead to the specification of the minimum necessary differentiation of training techniques and materials required for such a variable population. More ambitiously, we expect that tailoring search and scanning strategy training to categories of children that can be confidently identified in terms of developmental status and cognitive style will be more generally effective than using traditional variables like intelligence and social class for the same purpose.

Research Strategy

Younger toddlers, especially impulsive ones on the KRISP are more attentive to stimuli or stimulus features that are salient because of physical features (brightness, contrast, location, size, change or movement, complexity, novelty, etc.), while older preschoolers, especially reflective ones on the KRISP, have begun to respond under favorable conditions by analyzing, discovering, or at least looking for, relevant and informative features as defined by organization of materials and task requirements. Consequently the former tend to explore passively and erratically, while the latter tend to search actively and more systematically. Facilitation of this transition can be accomplished best in children who are ready to make it, and they, in turn should be identifiable by their pattern of time and errors on the KRISP.

The basic studies thus begin by identifying reflective, impulsive and intermediate children at the three-, four- and five-year-old levels. Typically these scores are coded so that all the staff are "blind" as to any child's KRISP scores until all the data are in. In most of the studies, a task, such as matching to sample, matching from memory, classifying, or simply discriminating compound stimuli, is devised which permits reliable recording of both attending behavior (eye movements, hand movements in a haptic task, or task, or slide changes under the child's control) and solution behavior (correct discrimination, matching, or classifying), which is usually directly reinforced. Then two or more groups of subjects, stratified on age and KRISP classification, are selected. One group receives attentional training on practice items by means of modeling, direct shaping of observing responses, or fading from stimuli that by design attract attention to relevant features, toward stimuli that contain the relevant cues imbedded in a distracting complex of irrelevant cues. At least one group receives equivalent practice and exposure without systematic training as a placebo. Results are analyzed using subject-type by treatment anova models, with particular attention to the interactions between subject variables on which the groups were stratified (age and style) and the various training vs. control manipulations employed.

What is uncommonly done in the literature, but is especially useful in these designs, is to analyze observing responses (attention and scanning) both as a dependent variable and as a co-determinant of the correctness of the child's final choice or decision. Thus we can establish when attention is indeed the intervening variable that determines the effects of subjects and treatments on learning, because when it so functions, the observing behavior we attempt to teach both improves and is correlated with terminal accuracy of response. If the training facilitates learning by some other means than improving observing behavior, that fact shows up in this design. Correspondingly, if the subject variables affect learning, either mediated by attending behaviors or not, but the treatments are not effective, that too is manifest in the results. Finally, the differential effectiveness of various training techniques for improvement of both search strategies and terminal decision making by the child can be assessed for each age and style group studied. Such treatments can thus be differentially prescribed for other children.

Children are typically studied one at a time in an experimental room or mobile laboratory set up typically with back-projection slide displays or haptic stimuli. Their eye movements or hand movements are recorded on, and scored from, video tapes. Their choice behavior consists usually of pointing to the required stimulus, rather than any verbal response. The child changes his own slides when he is ready in most experiments. Reinforcement consists of praise or tokens that may be exchanged for a prize. Many variations have already been wrung on this basic technique, and its most innovative features are simply the recording of visual scanning without physical constraints and the systematic design and careful production of differentially interesting stimuli.

For KRISP development, as many subjects as can be secured nationally from age two to eight are being tested. Age and sex are the norming criteria, and most of the data have come from middle-class suburban and small-town populations. Smaller poverty, inner-city, and minority samples are being collected as well, together with trainable and educable retardates between ages of five and thirteen, both institutionalized and living at home.

Standard preschool, kindergarten, and daycare populations of children from the Lawrence community are involved in the basic research program, together with older comparison groups from public school classes at the second- to fourth-grade levels when needed.

The ages most appropriate for style-modification and style-task differentiation training have yet to be determined precisely, but lie within the range currently under study as described above.

Summary

In the individual reports that follow, we believe are the seeds of an emergent model for new ways of matching the deliberately arranged features of early childhood learning environments, including home, day-care, and preschool, to the most important parameters of individual children: their level of information processing competence and the cognitive styles with which they typically approach new learning situations. Such a model will, we believe, eventually be able to make a series of periodic assessments of the child's status, not so much in terms of achievement as in terms of attentional sophistication and readiness for well defined types of tasks, and in terms of how best to present such tasks to children of a particular cognitive style and level of readiness.

If the first part of such a model is designed to match the educational environment to the particular child, it follows that a similar effort may also be needed to match the readiness of the child to the particular educational demands that are about to be made upon him, especially in those settings that are not equipped to adjust so readily to the unique individual child. Thus we stress the development of intervention procedures, eventually designed to help atypical children make the minimum necessary accomodation to an educational system that is increasingly less tuned to their unique needs and more to general standards of cognitive competence. Both kinds of matching efforts are required, and although we are farther advanced on the first, we are hopeful that the two-faceted approach our research has followed will continue to feed both kinds of efforts.

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USER'S MANUAL FOR

THE KANSAS REFLECTION-IMPULSIVITY SCALE FOR PRESCHOOLERS

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THE KANSAS REFLECTION-IMPULSIVITY SCALE FOR PRESCHOOLERS

(KRISP)

The KRISP (Wright, 1971) is an individually administered test designed to identify those children between the ages of about 3 and 5 1/2 years who are unusually reflective or impulsive in their cognitive style or tempo (Kagan, 1966). It has been developed initially as a research instrument, but is eventually intended for use by teachers of preschoolers and other child care specialists, without extensive formal training in mental tests and measurements, as well as by psychologists. There are two comparable forms of the KRISP, each consisting of five practice items followed by ten test items. (The practice items for the two forms are the same). Each item is a match-to-sample problem requiring the child to find in an array of similar figures that one which is an exact copy of the standard stimulus appearing above the array. The child's total errors and mean time to first response on the ten test items are recorded as his scores. Figure A. is a KRISP item.

Insert Figure A. about here

Cognitive style (or tempo) is conceptualized as a dimension along which individuals differ in their typical speed and accuracy of performing tasks on which speed and accuracy are negatively related. The match-to-sample task has this property. That is, those who respond most rapidly tend to make the most errors, and those who respond most slowly tend to make the least errors. Fundamentally reflection-impulsivity is an individual characteristic somewhere between an intellectual ability, such as might be measured by an intelligence or aptitude test, and a personality trait such as might be measured on a personality inventory. It is a measure of a person's performance for, or tendency toward approaching information-processing tasks

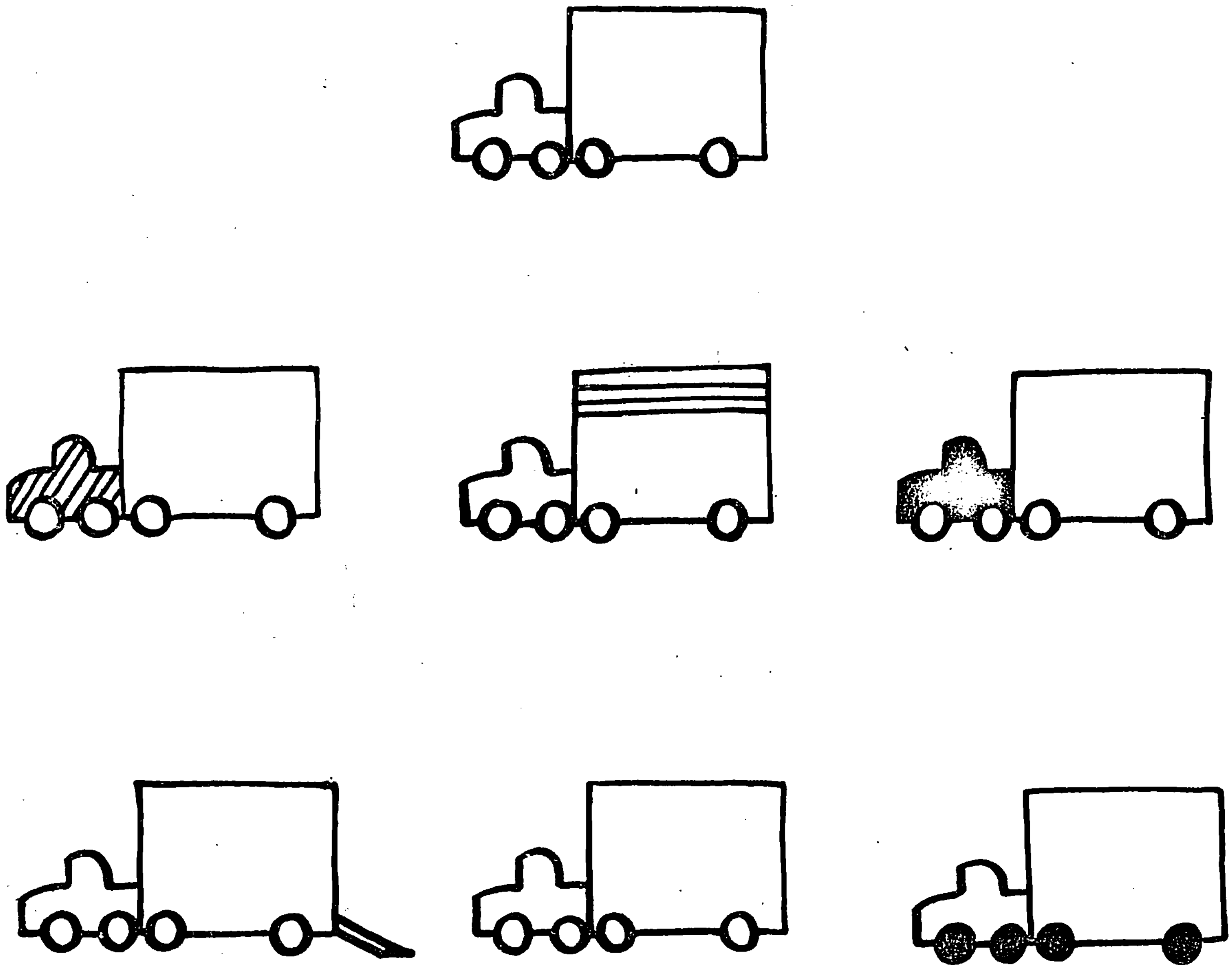


Figure A Sample KRISP Item

in a generally rapid, fluent, but imprecise way (impulsive) versus the opposing tendency to approach such tasks with caution, deliberation, and great concern for accuracy (reflective).

Although research has only begun on the generality of cognitive styles in young children, KRISP scores are likely to predict certain habits of thinking in a variety of situations even though the particular demands of the task and situation will, of course, play an important role in how a child performs. Children of these ages are much less fully developed in either intellectual abilities or personality characteristics, and users of the KRISP are cautioned that the stability of reflection-impulsivity, while fairly we established for older populations, has NOT been proved for children at the preschool level. It would therefore be risky to try to predict from KRISP scores at age four the cognitive style expected of a child at, say, age 8 or 10. Many experiences in the growth and development of the child after the preschool years are important and formative for the cognitive style that may become a more lasting characteristic of the individual in his more mature years.

Nevertheless, it appears useful to attempt to identify those preschoolers who are exceptionally impulsive or reflective now, because armed with that information, preschool teachers and others can select appropriate learning materials and settings for such children. Such choices then might both capitalize on children's natural tendencies, and help them prepare to deal with tasks on which their present cognitive style places them at a disadvantage compared with their less exceptional peers. For it seems that neither reflectivity nor impulsivity alone are always helpful or harmful to the child. While it is true that the reflective in general appears more intellectually mature and resembles children older than he, there are important areas in early education where the impulsive may enjoy a compensating advantage. For example, reflectives are typically better at "convergent thinking", that is thinking that requires careful analysis, accurate comparison, and the like in order to arrive at the single "correct" answer. But impulsives may have an edge when it comes to "divergent thinking" as exemplified in fluent expression in art and design, in expressive rhythm and body movement, or in story telling and creative imagination. If the impulsive child is sloppy, error-prone, and careless, he is also relatively free of compulsive worry about whether or not he is doing something "right." Conversely if the reflective is agonizingly slow and hypercritical of his own work, he may also be a very effective information-processor, with analytic skills unusual for one his age.

Ideally, of course, one might hope that most children are neither reflective nor impulsive across the board. A better goal might be for a child to discriminate those tasks and settings requiring a reflective approach from those benefitting from a more impulsive style, and to adjust his own behavior accordingly. At the very least we usually hope to develop in preschoolers a long enough attention span for them to be able to comprehend and carry out simple instructions accurately, together with freedom of self expression which permits them to use words, movements, musical sounds, and graphic materials with some fluency, if not artistry. Therefore the KRISP is intended to be useful not to diagnose some permanent incapacity or hidden talent, but to give the user a confirmation or disconfirmation of what may appear rather obvious to her, namely that a particular child seems unusually impulsive or reflective as compared with his peers.

Administration and Scoring

The KRISP is published with a set of instructions for administration to the child. The procedure is very simple, and requires only the use of a stopwatch and the appropriate score sheet. Figure B. shows a typical testing arrangement using a foot-actuated electric timer in place of a

Insert Figure B. about here

stopwatch, but the latter refinement is unnecessary in most applications. Basically the child is simply asked to find that member of the lower array which exactly matches the standard above. He is timed in seconds from the first exposure of an item until his first response (pointing to an alternative), whether correct or wrong. If he is correct, the tester simply goes on to the next item. If he makes an error on his first response, the tester gently informs him of that fact and invites him to try again. If his second response is also incorrect, he is permitted a third guess. But if he has still not pointed at the correct alternative after three errors, the tester goes on to the next item anyway. Thus the total errors in 10 items is a number ranging from zero to a hypothetical maximum of thirty. The mean response time for ten items is obtained by summing the individual times for the ten items, and then moving the decimal one place to the left (dividing by ten). Typical times to first response have ranged from two or three seconds up to fifteen or more. Figure (C) is a sample score sheet containing fictitious data on a fictitious child, and properly scored.

Insert Figure C. about here

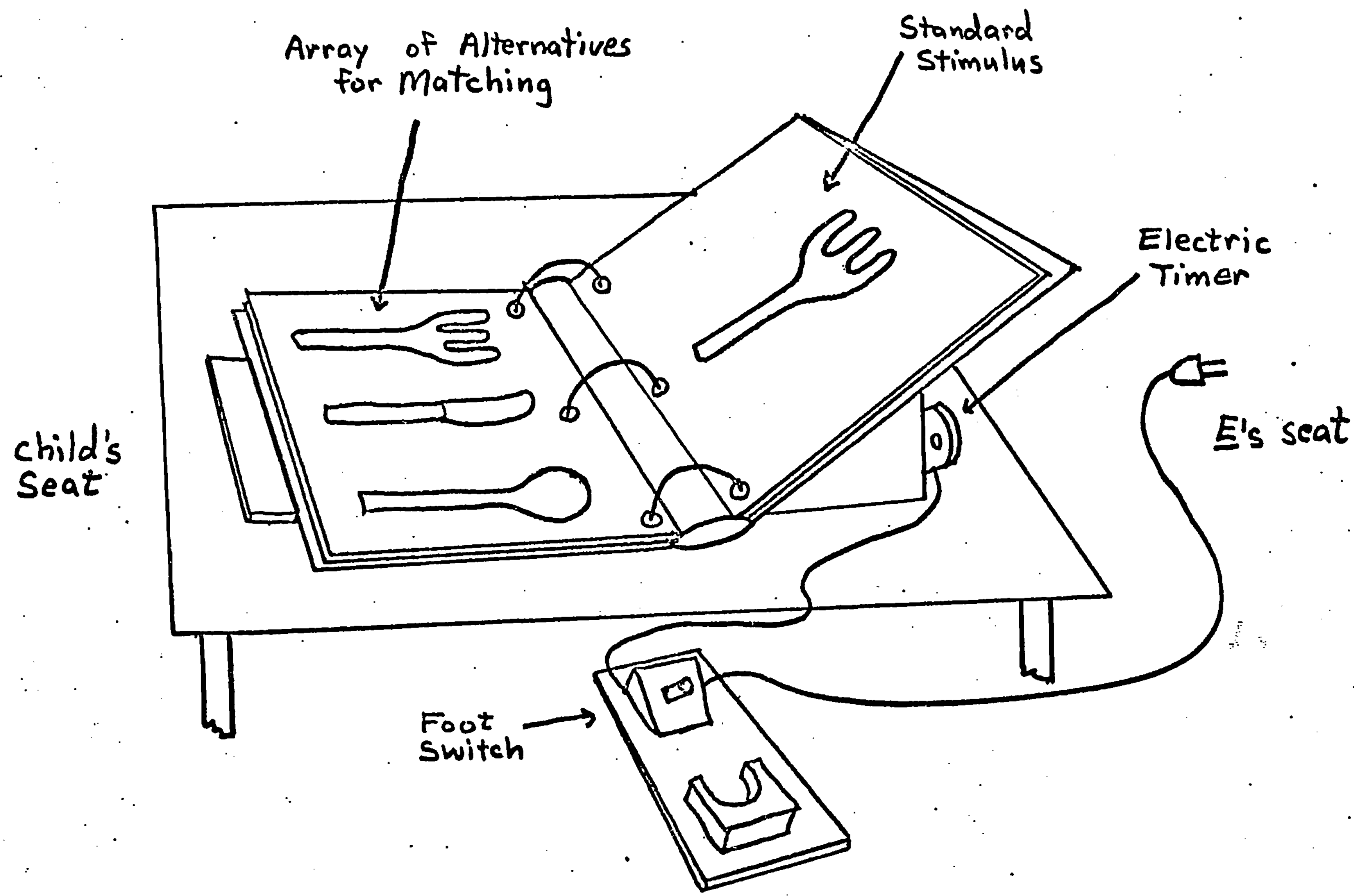


Figure B. KRISP Testing Apparatus

SCORING SHEET KRISP FORM A

Number 021

Subject F. R. Date of birth 1/17/69 Date 1/15/73

Experimenter P. F. K. Reliability not checked Sex M

Stimulus	Correct Answer Seen by E	Response Time	Number of Errors	Comments
P-1 Circle	X 1	2.0 sec.	0	
P-2 Ice Cream	X 1	3.5	0	
P-3 Silverware	X 2 1	2.5	0	
P-4 Hat	3 X 1	3.0	0	
P-5 Umbrella	4 X 2 1	5.5	0	(hesitant)
A-1 Ball	4 X 2 1	6.5	0	
A-2 Candle	X 3 2 1	4.0	0	
A-3 Coat	4 3 X 1	7.5	0	
A-4 Pail	5 X 4 2 1	8.5	1	looked at me for answer
A-5 Wagon	5 3 4 2 X	4.0	1	
A-6 Pan	4 3 2 X	6.0	0	
A-7 Kite	5 3 X 2 1	3.5	0	much more confident
A-8 Truck	6 X 4 3 2 1	2.5	1	
A-9 Mouse	6 5 4 X 2 1	2.5	2	
A-10 Kitten	5 3 4 2 X	3.0	0	
		48.0	5	

Figure C. Sample Score Sheet

The remainder of this manual contains charts by which a preschooler can be compared with others of the same sex and approximate age. In these charts no percentile norms are provided, since we believe that the norms are not based on a large enough sample (305 youngsters in this edition) and also because cognitive styles, themselves, as stressed above, are not sufficiently stable or well defined at this age to warrant such precision. Therefore the charts are only designed to give a general indication of the direction and degree of impulsivity or reflectivity.

Figure I is a sample illustration of a plot of 12 widely scattered

---

Insert Figure I about here

---

children's KRISP scores. They are of course hypothetical cases. Each child's time and error scores serve to locate him at their intersect. Thus child number 6 made 9 errors and took about 4 1/2 seconds per item on the average. The box in the upper right-hand corner of the chart serves to identify the sex and age-range of children to whom that figures applies. Therefore the first step in evaluating a child is to locate the correct chart for his age and sex, and then to plot his point on the chart.

The final step involves a judgement as to whether the label for the graphic region into which a child falls is an appropriate label for the child in question. Again considerable caution should be employed. Firm conclusions require consistent supporting data, such as observation of the child, parental reports, and the like, and should not be drawn from KRISP data alone. A cautious interpretation of the hypothetical children plotted in Figure I might be as follows:

Children I, 2, 3, and 4 are very close to the average for their age and sex, and consequently we surmise that they are neither unusually

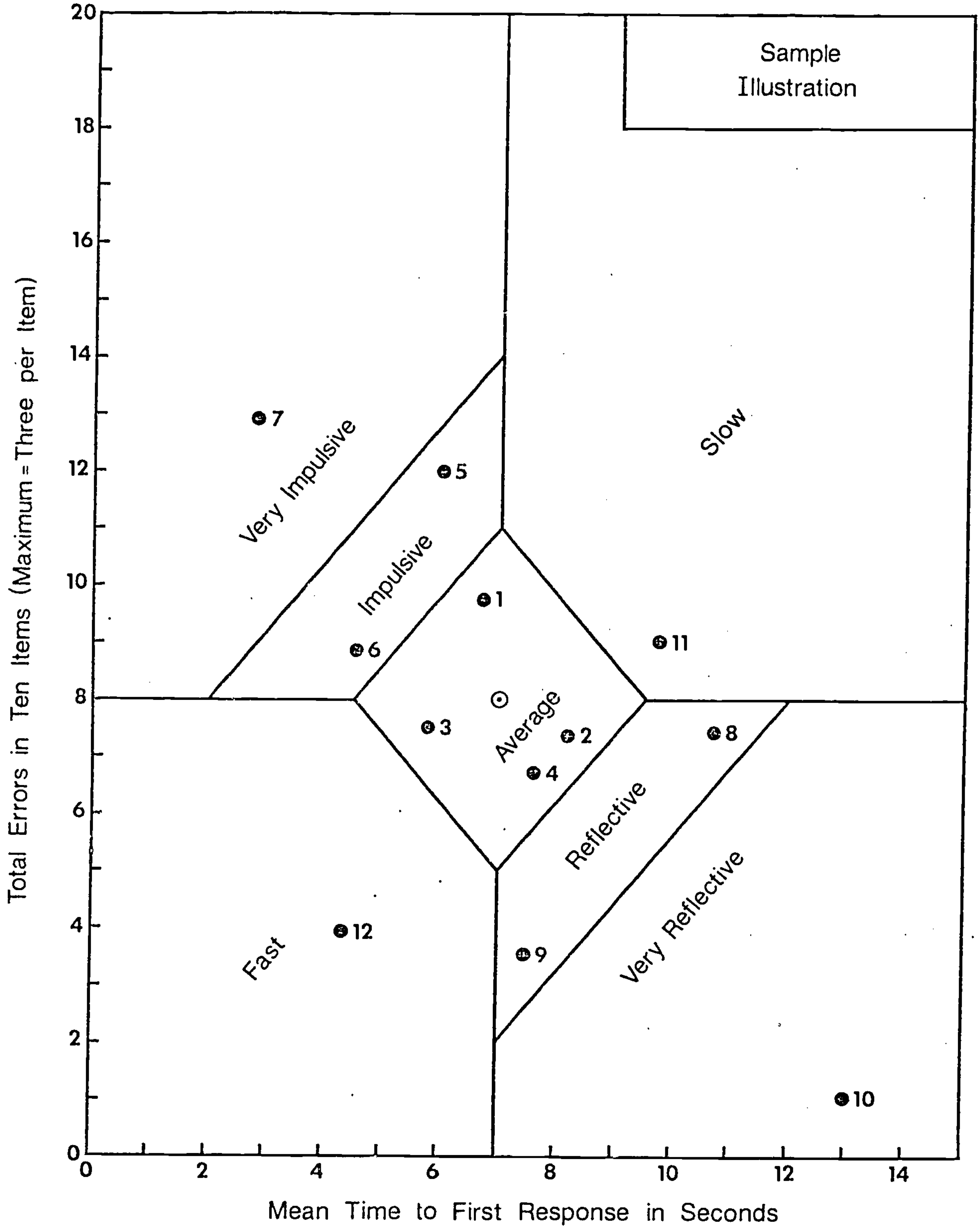

Sample
Illustration
Very Impulsive
Impulsive
Slow
Average
Reflective
Very Reflective
Fast
Total Errors in Ten Items (Maximum = Three per Item)
Mean Time to First Response in Seconds

Fig. 1

impulsive or reflective. Children 5 and 6 are probably somewhat impulsive relative to their peers. For child 5 this appears more as a high error rate, and for child 6 it appears more as a fast response rate. Because child 7 is nearly two steps (technically these are standard deviations) above the mean in errors and below it in time, we would feel more confident in concluding that he is impulsive.

Correspondingly, children 8 and 9 score on the reflective side, but in different ways. Child 8 is very slow, but near average in errors, while child 9 is very accurate, but only a little slower than average. Child 10, however, clearly appears to be reflective by both criteria.

While most of the children tested will distribute themselves on such a chart in an elliptical scatter from the upper left corner (impulsive) to the lower right corner (reflective), a few children will always fall in the less populated lower right and upper left quadrants. Children 11 and 12 are examples, and would be labelled "slow" and "fast", respectively. Clearly they are neither reflective nor impulsive on the KRISP, but they do differ. Some studies have indicated that children who, like child 11 are slow and make more errors than average differ from children like child 12, who is fast and makes few errors, in their general intelligence rather than in their cognitive style. One should be very cautious about drawing such conclusions from KRISP plots, however. More justifiable would be that although child 12 is faster and more accurate than the average by a good margin, and is therefore probably unusually skilled at rapid visual analysis (and perhaps quite bright), no opposite conclusion can be validly drawn about child 11. This is not only because he differs only slightly from children 1 to 4, who are "average", but also because a wide variety of unknown factors could have caused him to be somewhat slower and less accurate then we would expected. We should therefore consider child II also as being average in the absence of any other indications.

It is acknowledged that these categories are rather imprecise, but the current state of development of this test, together with the inherent instability of any scores on children of these ages, has prompted a corresponding coarseness of classification as a cautionary measure. Those using the KRISP for research purposes should use mean time and total errors to compare their results to the research findings of others. An interim technical report on the KRISP is available (Wright, 1972). The tentative norming sample for this edition is comprised of suburban and small town, mostly caucasian, children who attended a university preschool or a public kindergarten.

The author would greatly appreciate receiving data from KRISP administrations to normal samples of children. Such data will be incorporated in future norms if they are identified as to a) testing conditions and procedural anomolies, if any; b) exact age at time of testing; c) sex of child; d) setting from which the child came (e.g., daycare, private preschool, Head Start, etc.); and e) the general composition of the sample (e.g., community size, general socio-economic level, racial/ethnic composition, etc.)

Insert Figures 2, 3, 4, 5, 6, & 7 about here

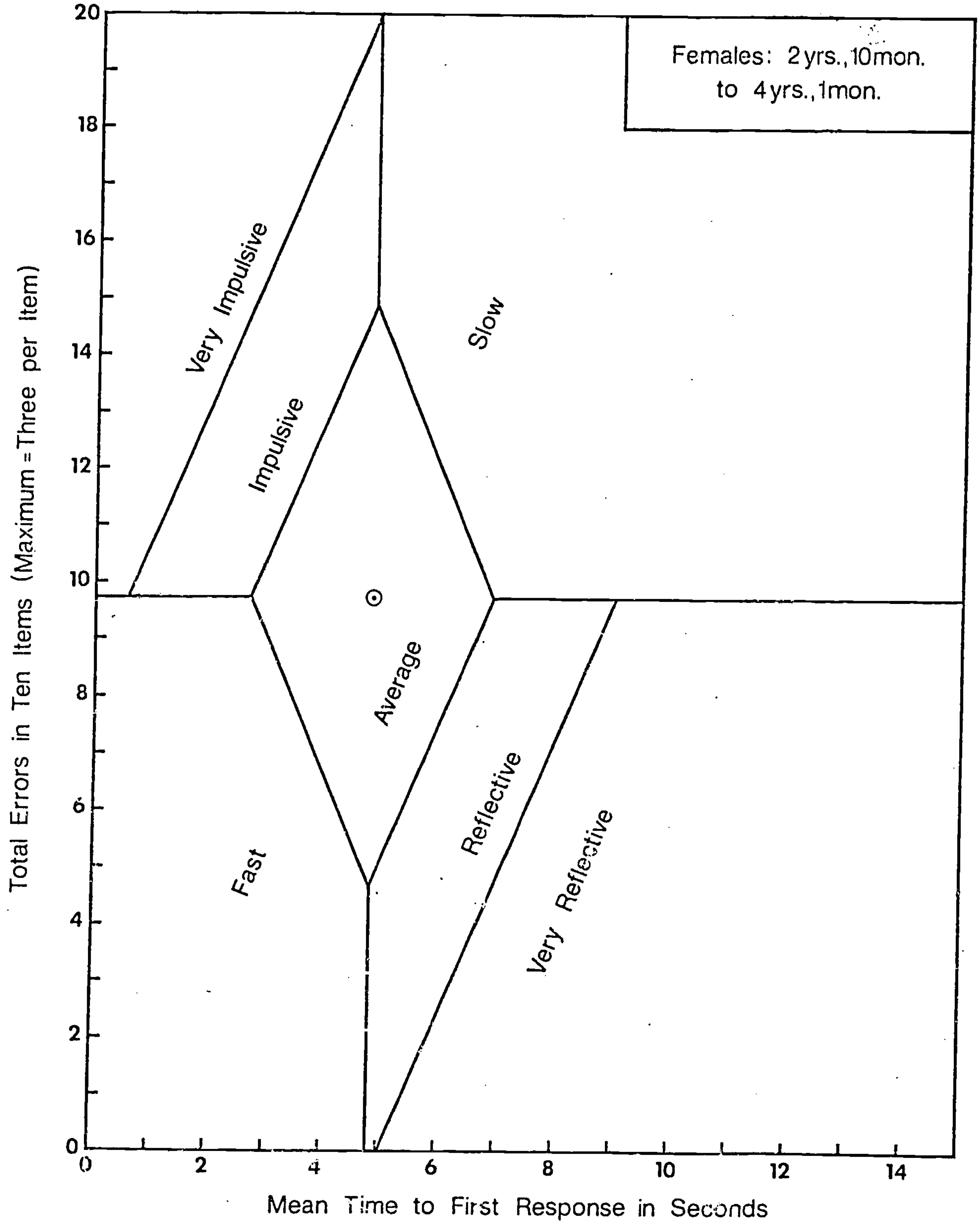

Females: 2 yrs., 10 mon. to 4 yrs., 1 mon.
Total Errors in Ten Items (Maximum = Three per Item)
Mean Time to First Response in Seconds
Very Impulsive
Impulsive
Slow
Average
Fast
Reflective
Very Reflective
0
2
4
6
8
10
12
14
16
18
20

Fig. 2

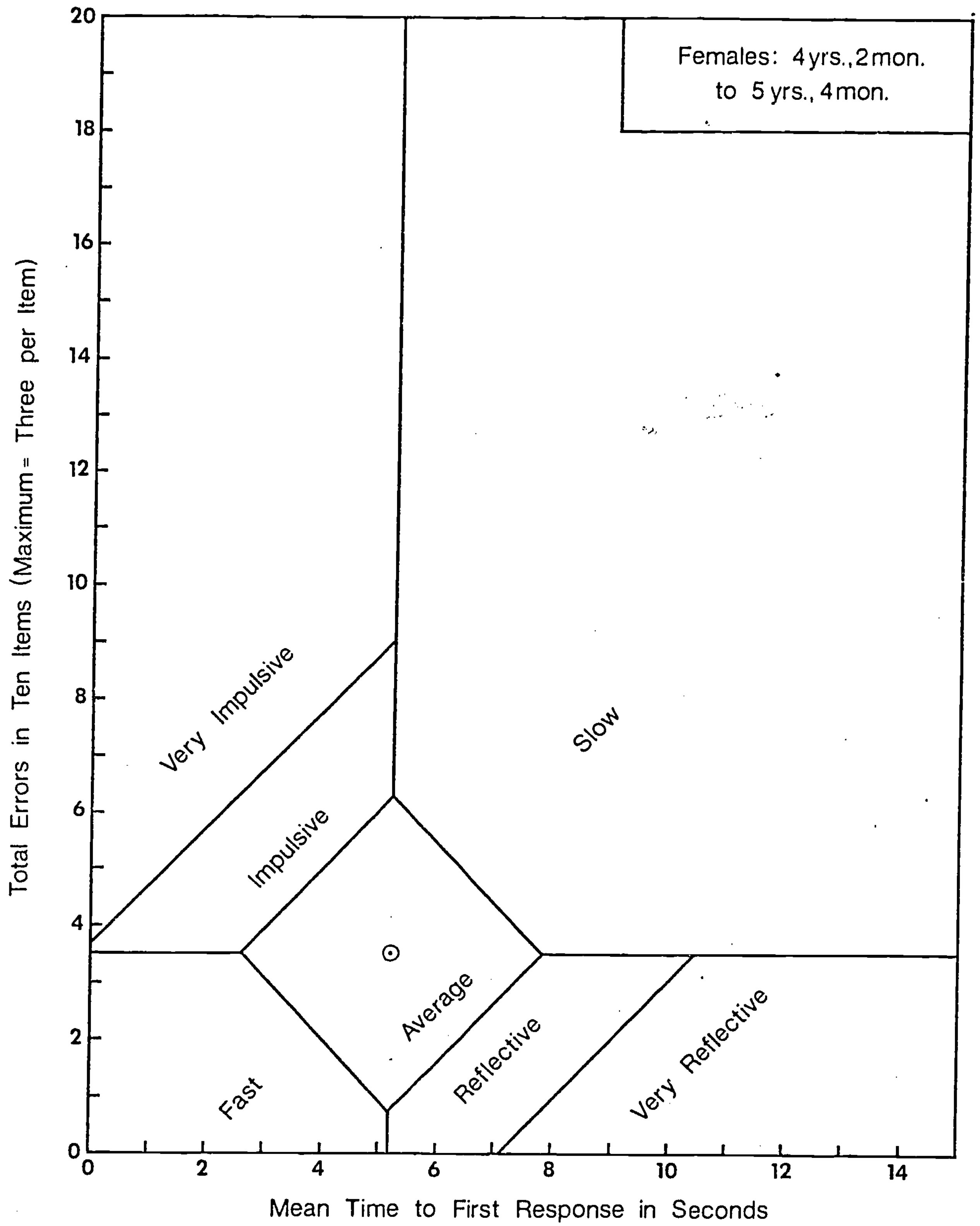

Females: 4 yrs., 2 mon.
to 5 yrs., 4 mon.
Total Errors in Ten Items (Maximum = Three per Item)
Mean Time to First Response in Seconds
Very Impulsive
Impulsive
Slow
Average
Fast
Reflective
Very Reflective
0
2
4
6
8
10
12
14
16
18
20

Fig. 3

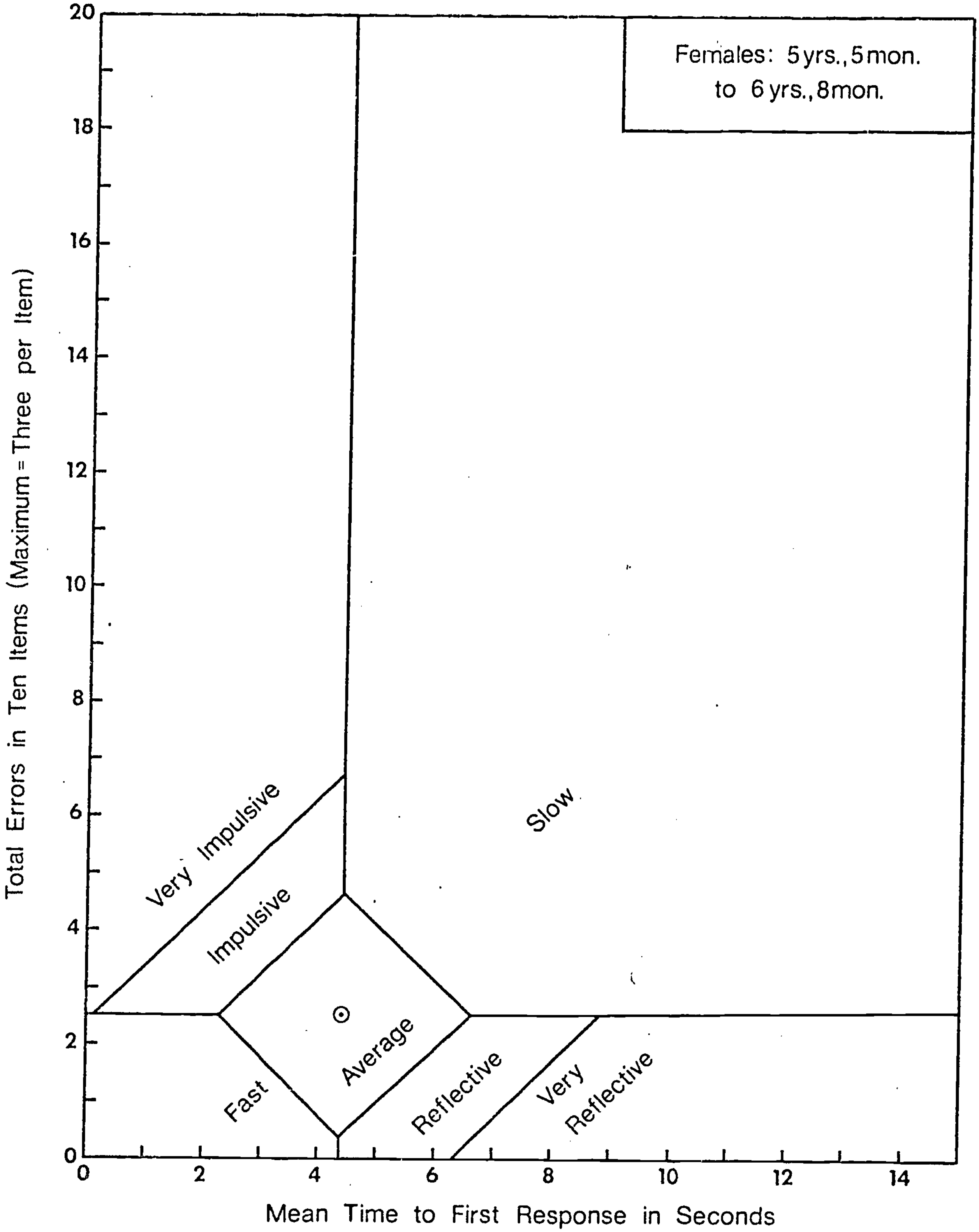
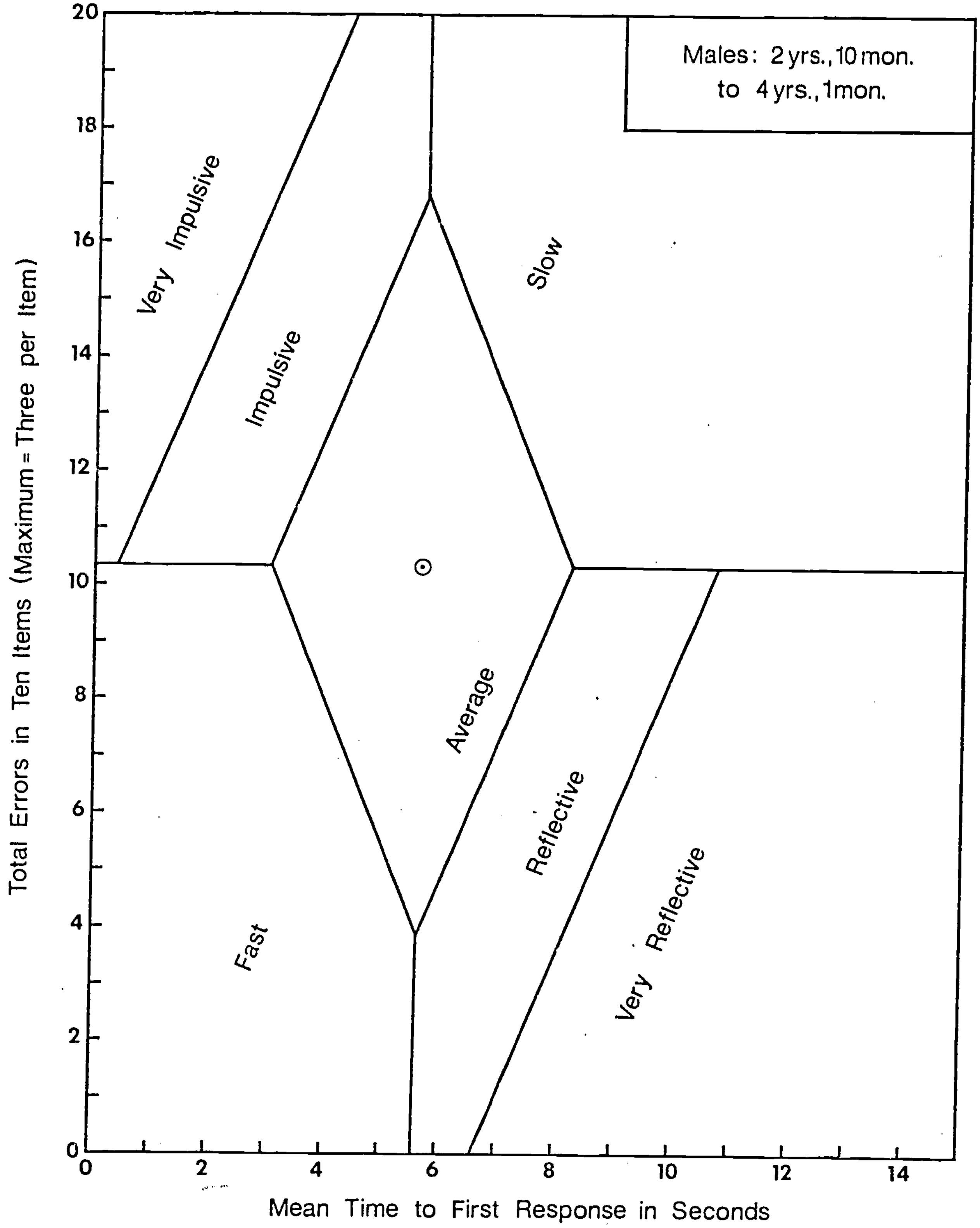

Females: 5 yrs., 5 mon. to 6 yrs., 8 mon.
Total Errors in Ten Items (Maximum = Three per Item)
Mean Time to First Response in Seconds
Very Impulsive
Impulsive
Slow
Average
Fast
Reflective
Very Reflective
0
2
4
6
8
10
12
14
16
18
20

Fig. 4



Males: 2 yrs., 10 mon. to 4 yrs., 1 mon.
Very Impulsive
Impulsive
Slow
Average
Reflective
Very Reflective
Fast
Total Errors in Ten Items (Maximum = Three per Item)
Mean Time to First Response in Seconds
0
2
4
6
8
10
12
14
16
18
20

Fig. 5

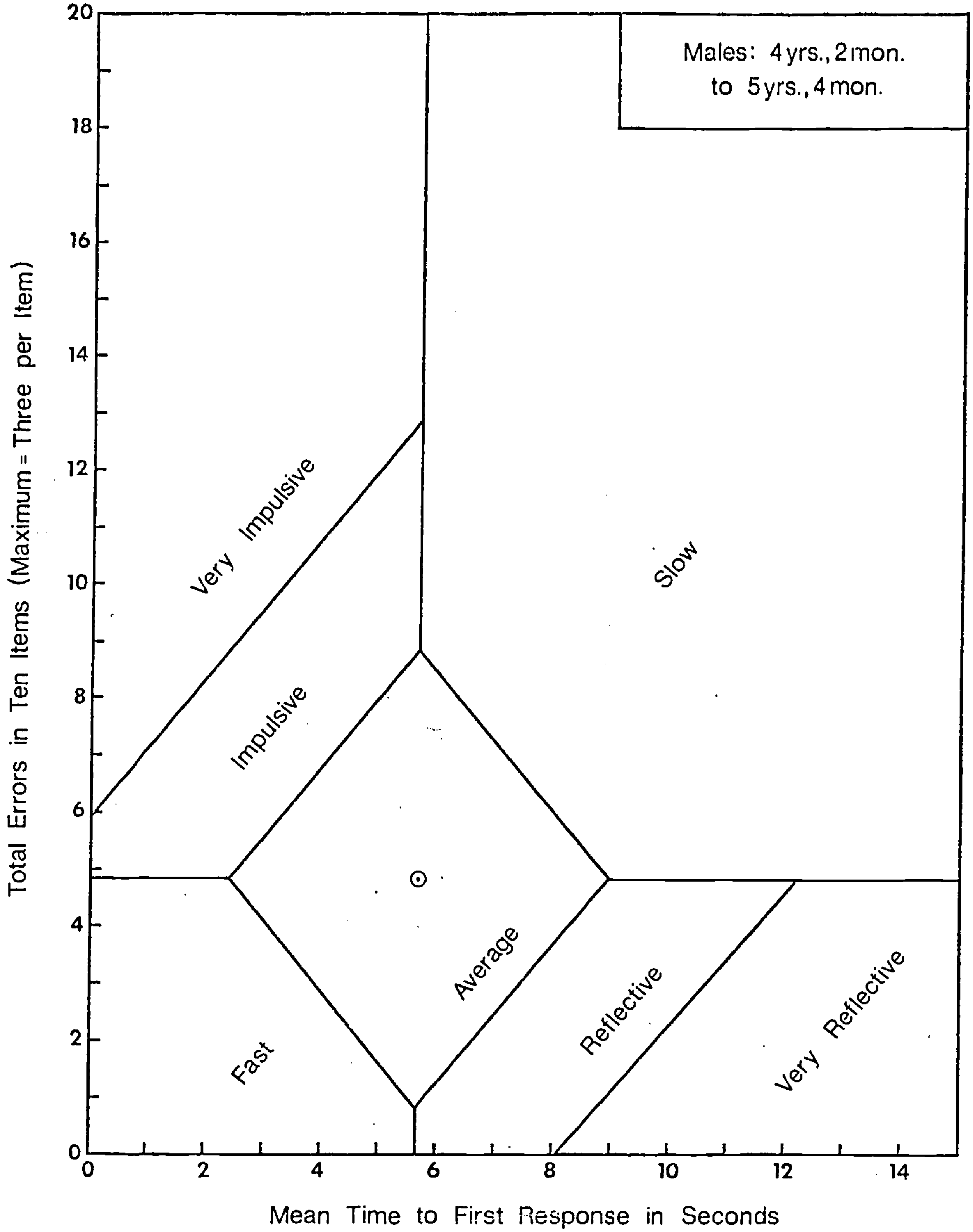

Males: 4yrs., 2mon. to 5yrs., 4mon.
Total Errors in Ten Items (Maximum = Three per Item)
Mean Time to First Response in Seconds
20
18
16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
Very Impulsive
Impulsive
Slow
Average
Fast
Reflective
Very Reflective

Fig. 6

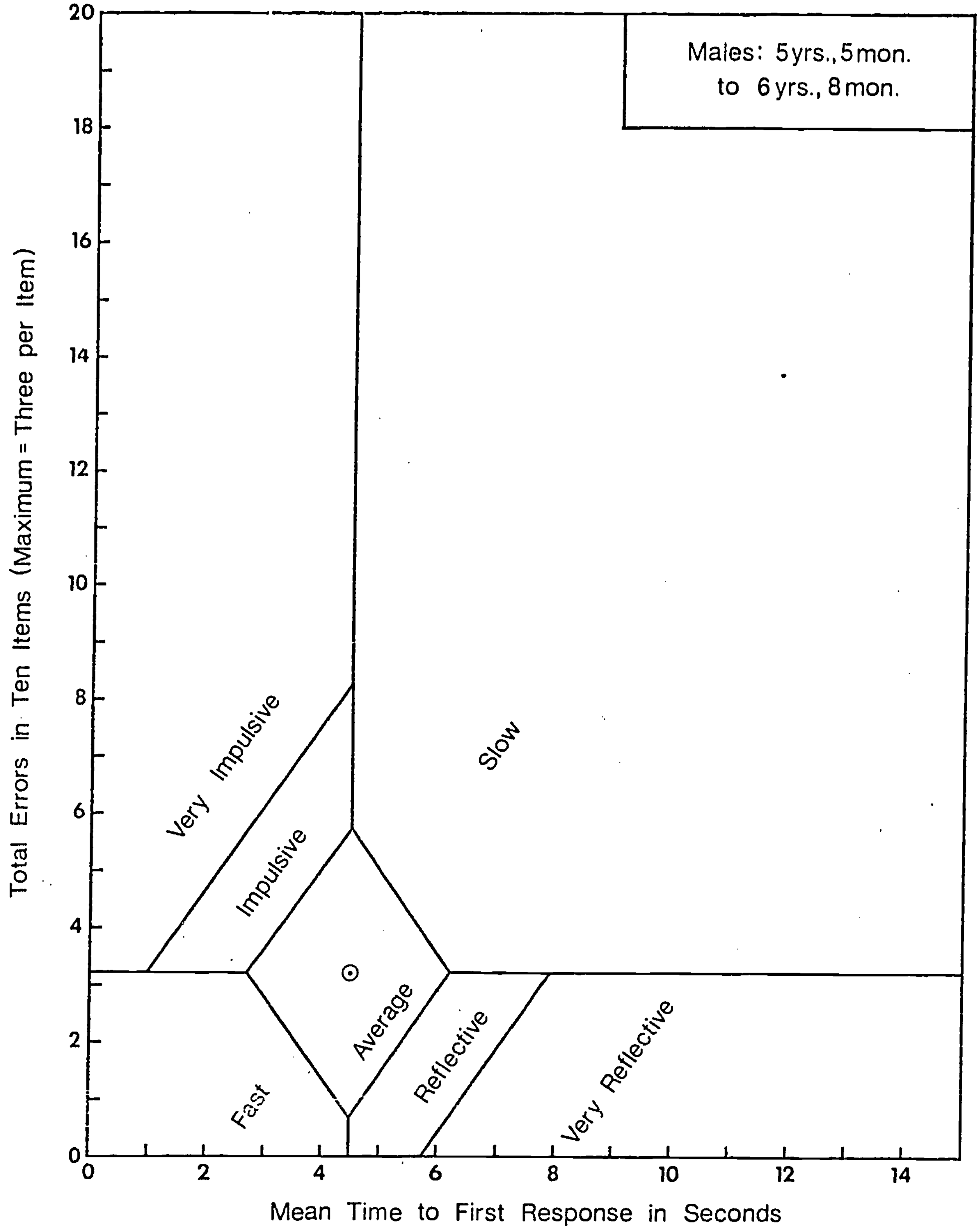

Males: 5yrs., 5mon.
to 6yrs., 8mon.
Total Errors in Ten Items (Maximum = Three per Item)
20
18
16
14
12
10
8
6
4
2
0
Very Impulsive
Impulsive
Slow
Average
Fast
Reflective
Very Reflective
0
2
4
6
8
10
12
14
Mean Time to First Response in Seconds

Fig. 7

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Wright, J. C. The Kansas Reflection - Impulsivity Scale for Preschoolers (KRISP). St. Louis: CEMREL, Inc., 1971.

Wright, J. C. Technical report on the KRISP. In Annual Report, Kansas Center for Research in Early Childhood Education, University of Kansas, 1972.

The KRISP*: A Technical Report

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KANSAS CENTER FOR RESEARCH IN EARLY CHILDHOOD EDUCATION

University of Kansas

Project Code No. 3HOK03-3
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3HOK03-8

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*The Kansas Reflection-Impulsivity Scale for Preschoolers (Wright, 1971) and a User's Manual for the KRISP (Wright, 1973) have been published elsewhere. This report supplies supplementary technical data on the KRISP and assumes the reader's familiarity with the test.

Introduction

The Kansas Reflection-Impulsivity Scale for Preschoolers (KRISP), initially developed as a research instrument (Wright, 1971) is now being normed and prepared for wider, though still experimental, use under ordinary user conditions by personnel without specialized training. For this purpose a user's manual (Wright, 1973) has been written in non-technical language and format, containing preliminary norms in the form of comparison charts based on the 307 children tested by the Kansas Center for Research in Early Childhood Education, University of Kansas, during the past two years. While a much larger number of cases is being tested for inclusion in subsequent norms, it appears useful to analyse the data in hand for a preliminary report to accompany the interim norms now being distributed. The present report is based on 307 children tested in the Lawrence and Kansas City, Kansas areas in 1971 and 1972. They come from a generally middle class population and are otherwise unselected. The greatly enlarged norming population now being studied will include a number of different regions in the United States, more varied populations (urban, inner city, suburban, and small town), together with sample data from Canada, Great Britain, West Germany, Belgium, and Australia. Doubtless it will prove necessary and desirable to replicate the analyses reported here on the larger sample, and to extend them to include regional and international comparisons as well as demographic contrasts not yet possible with existing data.

Results

Table I shows the basic KRISP data (mean time to first response and total errors in 10 items) averaged separately by age and sex and combined in various ways. The findings are based only on the first

Insert Table I
about here

administration of the KRISP to each child, and a random half of the Ss in each age x sex cell were tested with Form A, the rest on Form B. (See below for interform comparisons).

Sex Differences in speed and accuracy.

The overall sex difference in time indicates that females respond slightly faster than males, but the difference is not significant [$F(1,299) = 2.18$, n.s.]. That females make fewer errors, however, is a significant finding [$F(1,299) = 4.28$, $p < .05$]. The sex-by-age interactions are not significant, yielding F-ratios of less than 1.0 for both time and errors.

Age Differences in speed and accuracy

The effect of age was analysed by comparing the three age levels used in norming: "young" (2 yrs., 10 mon. to 4 yrs., 1 mon.); "middle" (4 yrs., 2 mon. to 5 yrs.. 4 mon.); and "old" (5 yrs., 5 mon. to 6 yrs., 8 mon.). Time scores yield a hump-shaped function with age, with the middle group responding slowest and the old group responding fastest. This rather small effect is nonetheless significant [$F(2,299) = 4.52$, $p < .05$]. For errors, however, there is a large, decelerated improvement with age that is highly significant [$F(2,299) = 79.98$, $p < .001$]. No age by sex interactions were significant. Figure I shows these results.

Insert Figure I about here

Table 1. Interim norms for KRISP time and errors as a function of age and sex.

Age Range	Sex	N	Mean Time to First Response (sec.)		Total Errors in Ten Items	
			Sample mean	S.D.	Sample mean	S.D.
Young[1]	Female	51	4.72	2.06	9.80	5.14
Middle[1]	Female	26	5.23	2.63	3.48	2.76
Old[1]	Female	69	4.44	2.14	2.50	2.07
Combined	Female	146	4.68	2.22	5.20	4.89
Young	Male	51	5.59	2.39	10.35	6.04
Middle	Male	32	5.65	3.25	5.28	4.15
Old	Male	78	4.41	1.77	3.20	2.49
Combined	Male	161	5.03	2.41	5.88	5.28
Young	Combined	102	5.16	2.27	10.08	5.62
Middle	Combined	58	5.47	3.00	4.49	3.71
Old	Combined	147	4.43	1.95	2.87	2.33
All Subjects		307	4.87	2.31	5.56	5.11

[1] Note: "Young" subjects defined as 2 yrs., 10 mon. to 4 yrs., 1 mon.
"Middle" subjects: 4 yrs., 2 mon. to 5 yrs., 4 mon.
"Old" subjects: 5 yrs., 5 mon. to 5 yrs., 8 mon.

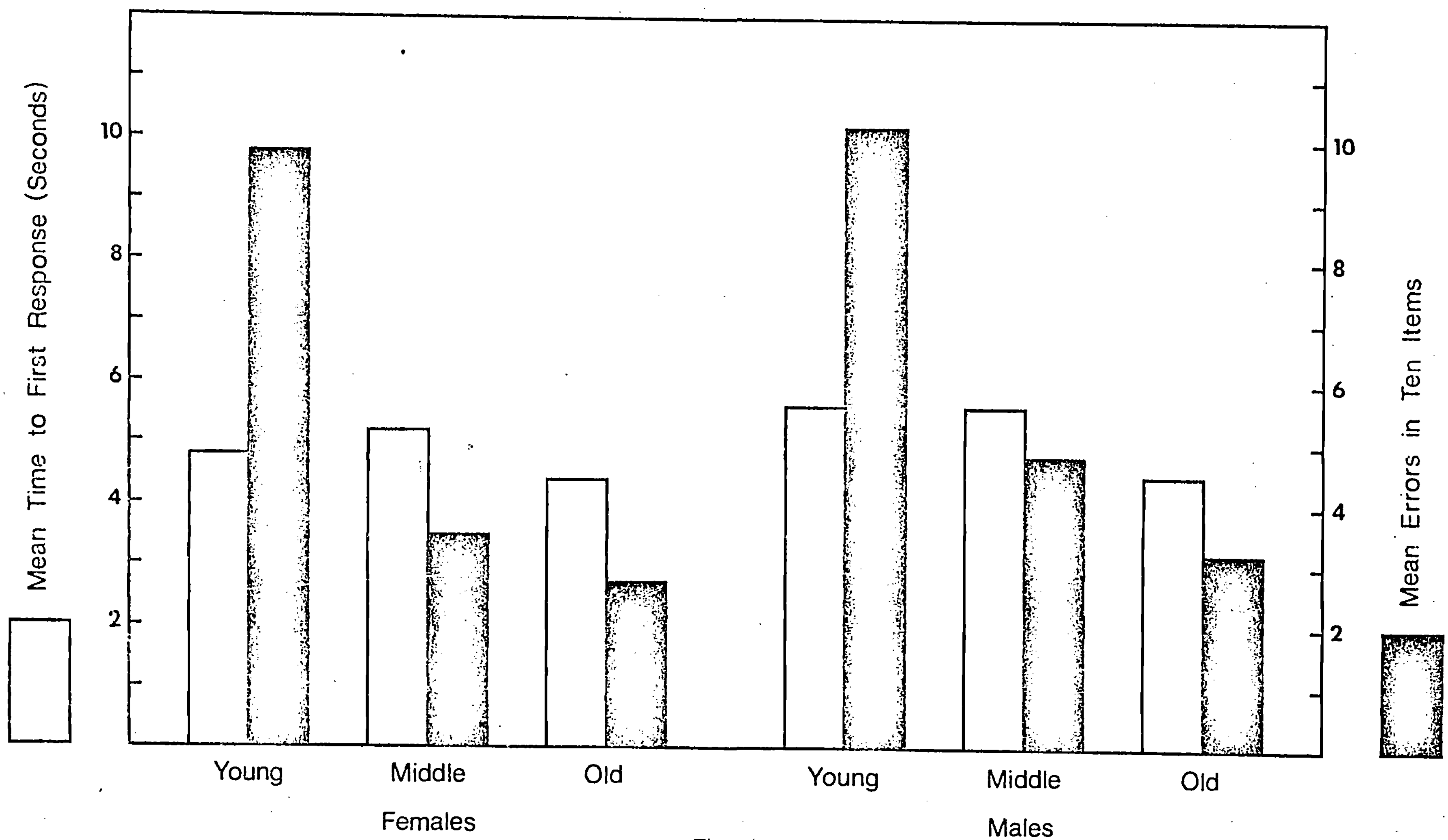
Mean Time to First Response (Seconds)
Mean Errors in Ten Items
10
8
6
4
2
Young
Middle
Old
Females
Young
Middle
Old
Males

Fig. 1

Relationship between speed and accuracy

Pearson product moment correlations between mean times and total errors are reported in Table 2. Others, e.g., Kagan (1966), have

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Insert Table 2 about here

---

generally found with older children on their MFF test that speed and accuracy are negatively related, with correlations running between -.40 and -.60. As can be seen, the same correlations on our present KRISP data yield uniformly negative, but substantially smaller correlations, perhaps due to the restriction of range, especially of time scores, or perhaps due to the fact that a larger number of experiential variables appear to influence younger children's scores, especially their accuracy scores. In any case the pattern of a generally negative relationship between time and errors appears to be established in Table 2, and it is stronger for males than for females.

Interform reliability.

Most of the Ss for whom the first administration of the KRISP yielded the data analysed above were also given a second administration less than ten days later using the other form of the test. By the use of t-tests for correlated samples, the data from Form A (half first session, half second session, same Ss) were compared with those from Form B in each of the six age-by-sex cells. None of the t-tests yielded values approaching significance (all t-values less than 1.0) for either time or errors. Correlations between Form A and Form B on various combinations of 188 Ss are given in Table 3. In general it appears that satisfactory inter-form reliability has been demonstrated.

Insert Table 3 about here

Table 2. Pearson correlations between mean time to first response and total errors on ten KRISP items by age and sex.

	Male Ss		Female Ss		Sexes Combined	
	N	r	N	r	N	r
Young Ss (2 yrs., 10 mon. to 4 yrs., 1 mon.)	51	$-.44^{e}$	51	$-.08$	102	$-.28^{d}$
Middle Ss (4 yrs., 2 mon. to 5 yrs., 4 mon.)	32	$-.36^{a}$	26	$-.11$	58	$-.25^{a}$
Old Ss (5 yrs., 5 mon. to 6 yrs., 8 mon.)	78	$-.27^{c}$	69	$-.22^{a}$	147	$-.16^{a}$
Ages Combined	161	$-.17^{b}$	146	$-.06$	307	$-.11^{a}$

Significance code:

a: $p < .05$; b: $p < .02$; c: $p < .01$; d: $p < .005$; e: $p < .001$.

Table 3 Pearson correlations between Form A and Form B

	Young Ss		Middle Ss		Old Ss		Ages Combined	
	N	r	N	r	N	r	N	r
Male Ss								
Time	51	+.59	32	+.75	13	+.33	96	+.61
Errors	51	+.72	32	+.72	13	+.77	96	+.77
Female Ss								
Time	51	+.60	26	+.83	15	+.74	92	+.70
Errors	51	+.71	26	+.51	15	+.53	92	+.80
Sexes Combined								
Time	102	+.60	58	+.78	28	+.60	188	+.72
Errors	102	+.72	58	+.66	28	+.74	188	+.78

Test-retest reliability

Session I scores were compared with Session 2 scores to determine whether on a second administration of the KRISP, using the other form, a practice or warm-up effect can be expected. For time scores, the answer is clearly no, since none of the *t*-tests yielded significant changes for any age x sex cell or combination of cells. For errors, however, there appears to be a definite practice effect leading to error reduction on the second administration. Table 4 summarizes these changes and their significance.

Insert Table 4 about here

The data reported in Table 3 were arranged to correlate Form A (regardless of which session it was given in) with Form B (also regardless of session). A rearrangement of the same data permits the correlation of Session I data (regardless of Form) with Session 2 data (regardless of form). The resulting correlations are given in Table 5. Again

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Insert Table 5 about here

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satisfactory reliability appears to have been established despite the practice effects that differentiate Session I from Session 2 scores. However, separate norms will probably be needed for "second administrations" of the KRISP.

One-year Stability

Since the KRISP measures variables of unknown stability, especially at the younger end of its range, it was decided to study stability of KRISP performance over a one-year period, beginning with three-year-olds. Unfortunately, at this stage, the only Ss that could be easily

Table 4. One-week (other form) retest changes for KRISP time and errors.

	Time (sec.)					Errors			
	N	Change (±)	t	d.f.	p*	Change (±)	t	d.f.	p*
Young Males	51	+.02	0.05	50	n.s.	-3.10	6.33	50	.001
Young Females	51	+.17	0.53	50	n.s.	-0.92	1.61	50	n.s.
All Young	102	+.09	0.35	101	n.s.	-2.01	5.15	101	.001
Middle Males	32	+.36	1.13	31	n.s.	-1.25	2.55	31	.02
Middle Females	26	+.29	0.76	25	n.s.	-1.19	2.25	25	.05
All Middle	58	+.33	1.38	57	n.s.	-1.22	3.99	57	.001
Old Males	13	+.39	0.76	12	n.s.	-1.62	2.25	12	.05
Old Females	15	+.73	1.87	14	(.10)	-0.33	0.85	14	n.s.
All Old	28	+.57	1.84	27	(.10)	-0.96	2.40	27	.05
All Males	96	+.06	0.24	95	n.s.	-2.28	6.91	95	.001
All Females	92	+.13	0.59	91	n.s.	-0.90	2.57	91	.02
All Ss	188	+.04	0.25	187	n.s.	-1.61	6.44	187	.001

* The probabilities reported are two-tailed. The t is for correlated samples.

Table 5 Pearson correlations between Session 1 and Session 2

	Young Ss		Middle Ss		Old Ss		Ages Combined	
	N	r	N	r	N	r	N	r
Male Ss								
Time	51	[illegible]	32	+.73	13	+.34	96	+.62
Errors	51	+.84	32	+.77	13	+.76	96	+.84
Female Ss								
Time	51	+.62	26	+.81	15	+.84	92	+.71
Errors	51	+.73	26	+.50	15	+.49	92	+.82
Sexes Combined								
Time	102	+.63	58	+.77	28	+.60	188	+.67
Errors	102	+.78	58	+.70	28	+.75	188	+.82

retested one year later were children in the University of Kansas Preschool who were still enrolled one year after their initial KRISP administration. Also awkward is the fact that they were some of the same Ss who contributed to the interform and one-week retest data described above, and had already had two KRISP administrations, a week apart, in the first year. Moreover, only 19 males and 21 females were available one year later.

Nevertheless it appears useful to analyse the effects of one year's growth and experience (including classroom training in preacademic skills and intensive participation as Ss in learning and cognitive research studies over that interval). Therefore within 10 days of the exact anniversary of their first KRISP, these Ss were given a third and fourth administration of the KRISP. Again half got Form A and then Form B, the other half got B then A this time. By t-test for correlated means (changes), time scores for males, females, and all Ss combined showed about a half-second decline over the year, a nonsignificant change. This finding is corroborated by the cross-sectional data in Table I, where young and middle Ss differed by about the same small amount in time scores. Errors, however, declined significantly, as they did in the cross-sectional study. For males the decline in errors was 3.68 [t (18) = 3.61; $p < .002$]. Again similar to the cross-sectional findings, the females' errors declined still more than the males: a decrease of 5.19 errors [t (20) = 4.36; $p < .001$]. Combining the sexes yields a mean change of -4.48 errors, which is also significant [t (39) = 5.67; $p < .001$].

Pearson correlations were calculated between year I and year 2 for both time and errors by using the average of the two administrations in the first year for the year I scores and the average of the second year administrations for the year 2 scores. This pooling of the two administrations separated by one week in each year was done a) because we were more interested in trait stability over a year than in test stability and therefore sought the best possible estimates of the child's "true" scores; and b) because by this method Form A and Form B contribute equally to the first year and the second year means for each dhild. Table 6 gives the anniversary correlations. As can be seen, they are not

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Insert Table 6 about here

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impressively strong for either time or errors, but in general females appear to be much more stable than males, judging from this small sample.

<u>Special Populations</u>

As has been mentioned, efforts are under way to obtain KRISP normative data stratified by population density (urban, suburban, small town, and rural); by socioeconomic status; and by nation and language groups. No results are yet analysed from these efforts. However one study, now three-fourths completed, is providing interesting data on the KRISP performances of retarded children. With the collaboration of Delores Segler and Jo Ramberg, we have administered the KRISP to 99 retarded children drawn from two residential institutions for retardates and special classrooms in two school districts where the children live at home. Groups of institutionalized trainables and educables have been run, as well as home-living trainables. Fifty-three home-living educables, to complete the design, have been contacted, but not yet tested. Nevertheless some preliminary analyses can be reported.

Table 6. Pearson correlations between the 3-year-old and the 4-year-old KRISP performances of the anniversary sample.

	N	Time	Errors
Males	19	-.16	+.09
Females	21	+.67[d]	+.42[b]
Sexes Combined	40	+.21[a]	+.33[c]

Significance code:

a: $p < .10$; b: $p < .03$; c: $p < .02$; d: $p < .001$

The institutionalized children were patients at the Parsons State Hospital and Training Center in Parsons, Kansas or the Kansas Neurological Institute in Topeka. Their stay at the time of testing averaged more than a year at Parsons, and more than six months at KNI. The non-institutionalized sample is drawn from the special classes for retardates at Grandview School, and from similar classes at Wellbourne School, both in Kansas City, Kansas. The comparison normals are from the University of Kansas Preschool. Table 7 shows the composition of the samples by age range and estimated I. Q. range and estimated mental age range. The

Insert Table 7 about here

IQs are approximations based on varying estimates available on the pre-school population as a whole, and in the folders of the retarded children. Often only one or two estimates were available per child, and the instruments used included the PPVT, WISC, Leighter, and Stanford-Binet. The PPVT scores were all discrepantly high, and were not used if another score was available. The educable-trainable distinction was routinely made as a classification by the Parsons' staff, and the other retardates were selected so as to approximate the Parsons' groups.

The KRISP was administered by a procedure as close as possible to the standard one. The only modification was occasional simplification and repetition of both instructions and the five practice items, as needed, with the retardate groups. No guidance or prompting was given once the test proper had begun. If a retarded child did not finish in ten minutes, he was re-tested, beginning all over with the practice items a day or so later. At the end of each session each retarded child received a small toy or a piece of candy.

Table 7. Characteristics of samples used in KRISP study of retardates.

Type of Child	N	C.A. Range	Approximate M.A. Range	Approximate I.Q. Range
Normal Preschoolers				
Younger	33	4 to 5 yrs.	4 to 6 years	100 to 120
Older	25	5 to 6 yrs.	5 to 7 years	100 to 120
Retardates*				
Trainables	70	8 to 14 yrs.	3 to 6 years	30 to 50
Educables	82	6 to 12 yrs.	4 to 7 years	50 to 70

* Approximately the same for institutionalized as for home-living. For sample sizes of each, see Table 8.

Table 8 gives the preliminary results. A formal analysis of variance awaits the testing of the 53 home-living educables, but preliminary

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Insert Table 8 about here

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t-tests indicate that retardates respond faster than normals ($p < .05$), and make more errors ($p < .01$). Trainables and educables respond about equally fast, but trainables make significantly more errors ($p < .01$). Institutionalized trainables are somewhat slower than home-living trainables ($p < .05$) and make many fewer errors ($p < .01$). In general, among the retardates, institutionalization appears to make for more reflective responding, while degree of retardation so far does not appear to have as strong effects as institutionalization. The main effect of retardation *per se* is that retardates have higher error rates than normals, as expected.

Summary and Conclusions

Initial norms on the KRISP indicate that females make slightly, but significantly fewer errors than males and are probably more stable over a one-year interval. Males show a stronger negative relation between speed and accuracy, but otherwise there are no marked sex differences. The effects of age (cross-sectionally and longitudinally) and practice are readily seen in the form of error reduction, but not as a systematic change in the speed of responding. The efficiency trade-off that with older school-age children on the MFF creates a sizeable negative correlation between speed and accuracy appears present, but much weaker, in KRISP data from preschoolers. All comparisons support the high agreement between Form A and Form B of the KRISP.

Table 8. KRISP Scores of Normal and Retardate Children.

		Time (sec.)		Errors	
	N	$\overline{X}$	S.D.	$\overline{X}$	S.D.
Younger Preschoolers	33	5.60	2.58	3.89	3.67
Older Preschoolers	25	[illegible].83	2.01	2.12	2.35
All Preschoolers	58	[illegible]	2.34	3.12	2.54
Trainable Inst. Retard.	33	5.12	1.89	5.59	3.40
Trainable Home Retard.	37	3.88	1.12	10.73	4.48
All Trainable Retard.	70	4.46	2.45	8.31	4.83
Educable Inst. Retard.	29	4.11	1.81	5.31	2.89
Educable Home Retard.	53	incomplete data			
All Educable Retard.	82	incomplete data			
All Inst. Retardates	62	4.64	2.54	5.46	4.65
All Home Retardates	90	incomplete data			
All Retardate Ss	152	incomplete data			

Retardates of the same mental age as the norming population respond more impulsively than normals, but degree of retardation appears to make less difference than institutionalization. Perhaps because they are not as protected as institutionalized children from tasks too difficult for them, the home-living retardates appear to develop an especially rapid and error-prone style. Conversely the children living in institutions either have stronger expectation of success, or perhaps a stronger, deprivation produced motivation to please adults who work individually with them, for they take longer and do better than their home-living peers.

So far the KRISP appears to be a reliable instrument, with face validity related to the MFF (Kagan, 1966), after which it was patterned. Its predictive validity has not been adequately tested as yet, but studies are under way (Wright, 1972) to assess its relationship to individual differences in infant attention as well as to the MFF performances of children as they reach school age. KRISP scores at age three may not predict KRISP scores at age four for boys, but they do for girls. The ability of the KRISP to predict other performances in other situations is being assessed in three experiments and one observational/correlational study in this laboratory (Wright, 1972), and it is hoped that by the time enlarged norms become available, a clearer picture of its ultimate practical usefulness will emerge. In the interim it appears to be a useful research instrument.

We may speculate that the error scores reflect an acquired ability to visual analysis, since they appear so much more susceptible to systematic changes than are time scores. The latter, on the other hand, are generalization or dishabituation on the test series. The long-term sequence hypothesis is thus not incompatible with the differential familiarity hypothesis, and both appear to receive support from these data.

These findings are comparable to McCall and Kagan's (1970) except for the slow habituators' reponses. The data presented show more habituation for this group than McCall's did. While these Ss continued to dishabituate to familiar and similar stimuli, indicating the presence of a conceptual category, they showed the largest proportional increase of response recovery to novel stimuli. While McCall, et.al. found that attention did not increase with increasing amounts of discrepancy from the familiar standard, the present study did show such results from each group of subjects. This difference might be attributed both to the stimuli used and to the ages of Ss. In this study each set of six slides was averaged, rather than being scored as single stimulus times.

Summary

The results of this study generally support the notion that the existence of protoconcepts can be demonstrated in toddlers. There was significant general response decrement of short-term duration over the habituation trials, longer term habituation within sessions (Misc. 1 - Misc. 2) and some decrement (not significant) between sessions (Session 1 - Session 2).

There was significant dishabituation (response recovery) of habituated slides when mixed with new test slides of similar and novel categories. There was always decreasing generalization of habituation from familiar, to similar, to novel slides.

Finally, there were consistent individual differences in habituation patterns. Those Ss showing least habituation (defined by habituation slope) showed least discrimination of familiarity vs. novelty. All groups showed discrimination between test slide types, but rapid habituators and slow habituators showed the most discrimination. The rapid habituation group, which showed steepest habituation slope also showed the largest dishabituation during the test set.

This study supports the proposition that habituation is a continuing phenomenon in the child's development. It is an adaptive process that enables the child to utilize stimuli efficiently. Less strongly supported is the possibility of habituation evidencing more conceptual learning processes. Habituation may be a process that facilitates learning by screening out familiar stimulus properties or familiar stimuli, but it does not necessarily indicate learning.

While generalized habituation was found in three year olds, it probably gives way to other conceptual processes in older children. It is possible that generalized habituation as a primitive perceptual organizer leads directly to other forms of mediation. Habituation may or may not continue to indicate perceptual learning in the older child. Nevertheless these data show an orderly process indicative of selective generalization of a discriminative response (habituated looking) within categories of stimuli, however the child may have achieved the grouping. Such data then indicate the existence of at least short-term protoconcepts in toddlers. Additional research may help determine the degree to which perceptual vs. conceptual processes underlie this phenomenon and whether protoconcepts do indeed mark an intermediate point in the development of grouping from stimulus generalization to conceptual categorizing.

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	The Effects of Contingent Modeling on Usage of the Passive Voice by Normal Preschoolers

KANSAS CENTER FOR RESEARCH IN EARLY CHILDHOOD EDUCATION

Project Code No. 4B0K06

Productive Speech Repertoires

THE EFFECTS OF CONTINGENT MODELING ON USAGE OF THE PASSIVE VOICE BY NORMAL PRESCHOOLERS

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A large body of research has demonstrated the influence of imitation in the :quisition of various behaviors exhibited by young children (Bandura, 1969), and ›veral learning theory accounts have outlined the possible role of imitation ı the acquisition of language (Mowrer, 1960; Risley, 1966).

A major objection to an imitative account of language development has 'isen from the observation that children emit a variety of verbal responses ıich have been neither modeled nor directly trained, and which are cited as :amples of "rule-governed" behavior (Brown & Bellugi, 1964; Ervin, 1964). erman (1972) has reviewed a number of studies in which such generalized res-nse repertoires have emerged as the result of training procedures involving deling and differential reinforcement.

In one of these studies (Guess, Sailor, Rutherford & Baer, 1968), a ten ar old retarded girl was reinforced for correct imitation of singular and ural labels, in response to objects presented to her singly and in pairs. ring the course of training, generalized plural usage resulted as the girl rrectly labelled new objects on their first prsentation. The child was sub-quently reinforced for reversed plural usage (providing plural labels for ngle objects, and vice-versa), and, finally, for correct pluralization. During :h of these conditions, generalized plural usage was observed which corres-ıded to the form being trained. In addition, words whose labels had been ןuired during reversed plural training were provided with correct plural labels ›n correct pluralization was trained, even though these words were not directly ıined.

Subsequent research with language deficient children has extended these ıdings by demonstrating the emergence of generalized response repertoires as 'esult of training a variety of language forms. These include pluralization ess, 1969; Sailor, 1969), adjective-noun combinations (Hart & Risley, 1968;

Hart, 1969), past tense verb inflections (Shumaker & Sherman, 1970), present tense of the verb "to be" (Fygetakis & Gray, 1970), and articles and auxiliary verbs (Wheeler & Sulzer, 1970). In all of these studies, training involved some form of modeling combined with reinforcement for correct usage; none of the studies attempted to evaluate the relative effects of these procedures.

The research which has attempted to evaluate the relative contributions of modeling and reinforcement has typically been conducted by exposing grade school children (whose language is presumably normal) to a fixed number of trials before and after exposure to a model. Bandura and Harris (1966) found that modeling alone did not produce changes in usage of either passive constructions or prepositional phrases, but modeling combined with reinforcement and instructions produced larger increases in both types of usage than did other combinations. Reinforcement and instructions without modeling also significantly increased usage of prepositional phrases, but not of passive constructions.

Rosenthal and Whitebook (1970) found that experimental groups exposed to modeling of simple sentences produced sentences similar to those modeled in terms of verb tense, structure and content significantly more often than a control group which was not exposed to modeling. This effect was retained when groups were subsequently exposed to a series of stimuli which were not modeled during training. The effects of modeling were confounded with those of incentives for one experimental group (i.e., the children were told to listen carefully, to learn as much as they could, and that they would be given a dime at the end of the game if they had done a good job) and with instructions for the other experimental group (i.e., children were told to listen carefully, to learn as much as they could, and to copy the model's sentences perfectly, if they could). Differences between these two experimental groups were minimal, with the exception that the group which received instructions matched the content of the model's utterance significantly more frequently than the incentive group.

Harris and Hassemer (1972) report that even without instructions to imitate or reinforcement children construct longer and more complex sentences after hearing complex sentences modeled than after hearing simple sentences modeled or after no modeling.

Malouf and Dodd (1972) trained the arbitrary ordering of nonsense adjectives (defined on body parts of a cartoon figure) with an automated device which presented pictures and sentences in various temporal sequences. Three experimental procedures were examined: (a) input: children were exposed to figures and sentences describing them, but made no overt responses during training, (b) imitation: children were exposed to figures and sentences describing them and were then asked to describe the figure aloud (they were not asked explicitly to imitate the model sentence), (c) expansion: children were shown the figure, asked to describe it, and then presented with the model sentence. Figures presented during training possessed only two of the three attributes being trained, and the model presented these attributes in a particular order on each trial. Training consisted of blocks of three training trials, each followed by a test trial. On the first trial, body covering and limbs were described; on the second, limbs and antennae; and, finally, body covering and antennae. On the test trial the figure possessed all three attributes, and the order in which the child described them served to measure the effects of training. Using these procedures, Malouf and Dodd found that the performance of expansion and imitation groups was superior to that of the input group, and that the expansion and imitation groups were not significantly different.

In a study using disadvantaged children as subjects, Lahey (1971) found that modeling alone produced a significant increase in the usage of descriptive adjectives by four of the five subjects exposed to it as compared to a group which was not exposed to modeling.

These studies have presented evidence that, under some conditions, modeling alone can produce significant changes in the language usage of children, and that (with the exception of the Harris & Hassemer study) this usage extends beyond forms which have been directly modeled. All have stressed that the forms examined were those which presumably existed at some strength in the children's repertoires prior to training, and that implications for theories of language acquisition are, therefore, unknown.

The only study which employed two language forms, Bandura and Harris (1966), found large differences in the children's usage of these two forms within the same experimental conditions. For example, when modeling, reinforcement and instructions were used, they observed larger increases in the usage of prepositional phrases than in usage of passive voice constructions (passives were used much more infrequently than prepositions during baseline). This maybe because the passive voice is a form which is acquired at a later point in development than other simpler forms (Leopold, 1953). Harwood (1959) found no occurrence of the passive voice form in the spontaneous speech of children with an average age of 5 years 8 months. Slobin (1964) reported finding occasional productions of passive sentences in the spontaneous speech of 7- and 8-year olds. Because the passive form is seldom, if ever, found in the speech of preschool children, and because it has been postulated as a complex grammatical form (Chomsky, 1957), it was selected as the form to be trained in the study to be presented.

The purpose of the study was to examine whether models of a correct form, contingent upon errors, would produce generative productive passive usage in preschool children.

METHOD

Subjects

The three girls and one boy who served as subjects were all normal children who attended the Edna A. Hill Laboratory Preschool of the University of Kansas.

Two subjects, Bertha and Lynne, were native English speakers, ages 3 years 5 months and 3 years 6 months, respectively. A third girl, Anna, age 3 years 11 months was a native Spanish speaker whose initial contact with English speakers occurred approximately six months before the study was begun, and in whose home Spanish was spoken exclusively. The fourth subject, Stan, age 5 years, whose native language was Tamil (a language spoken in southern India) had spoken English since the age of three. Both English and Tamil were spoken in his home.

Materials

Stimuli used on passive trials. Sixteen stimulus items (one per verb) were used. Each item consisted of six line drawings (3½"X3½" each) of two persons or animals (the agent and receiver of the action) together with the necessary props, mounted on an 8½"X11½" background sheet and covered by clear plastic.

On the top half of the page three pictures depicting the agent and receiver of the action before, during, and after the occurrence of an action were mounted in that order from left to right. These will hereafter be referred to as future tense, present tense, and past tense pictures, respectively.

The three pictures on the bottom half of the page were similarly mounted, but the agent and receiver of the action were reversed, e.g., if the top sequence showed the boy pushing the girl, the bottom sequence showed the girl pushing the boy. Figure 1 shows an example of a page.

Stimuli used on labelling trials. A variety of upper case letters (e.g., A,O) approximately 3" in height, drawn on 4" X 6" cards, small toys (e.g., mail box, boat), and animals (e.g., bear, dog) were used.

Procedure

The purpose of the procedure was to evaluate whether modeling correct passive usage contingent on errors would produce generative productive passive usage by the children. The productive passive task involved the production of a complete truncated (i.e., the agent of the action was deleted) passive sentence including the receiver of the action, the preverbal auxiliary, the verb, and the "ed" inflection (e.g., "The boy has been pushed.").

Throughout the study there were no consequences provided for correct passive usage. To provide reinforcement for the children's participation, a simple labelling task was presented at random points during each experimental session. Correct responses on labelling trials earned praise and tokens which could be exchanged at the end of the session for a small toy.

Experimental sessions. Experimental sessions, approximately fifteen minutes in length, were conducted four mornings per week (Monday through Thursday) in a small room located near the preschool classroom. The experimenter sat facing a low table, his back to a one-way observation window; the subject was seated to his left, on the adjacent side of the table. The score sheet, instructions, and pictures were placed in front of the experimenter. Two trays were located on the floor to the right of the experimenter. One tray contained the objects and pictures used during labelling trials; the other contained a variety of small toys from which the child could select a prize after earning the designated number of tokens. On the table between the experimenter and the child were two paper cups, one of which contained six tokens. Initially, the experimenter explained to the child that when "his" cup contained all six tokens the game would be over and he could exchange the tokens for a toy of his choice. The experimenter also explained that he would be unable to talk with the child until the game was over.

The types of trials presented to the subject during a particular session varied throughout the course of the study, but every session included six labelling trials. A labelling trial consisted of successive presentations of stimuli to the child until one of the stimuli was labelled correctly, and the subject received a social consequence and token. On labelling trials the experimenter held up an object or a drawing of an upper-case letter and asked, "(Child's name), can you tell me what this is?" If the child provided the correct label, the experimenter provided a social consequence ("Very good!" or "I can't trick you today!") and placed a token in his cup. If the child provided an incorrect label or did not respond within five seconds, the experimenter provided the correct label, e.g., "This is a bear.", and presented a new object or letter for labelling. This procedure was repeated until the subject provided a correct label. These trials were presented at random points throughout the session, the last labelling trial occurring after the sequence of non-labelling trials was completed. At this time the child exchanged the tokens he had earned for a toy.

In addition, if the child engaged in inappropriate behaviors during the session (e.g., emitted verbalizations unrelated to the task, left his seat), the experimenter lowered his head and did not respond until the child discontinued the inappropriate activity. If the children were cooperative during the session (i.e., did not engage in inappropriate behaviors), they were given a red token at the end of the session which could be exchanged in their classrooms for participation in special events. Only rarely did a child fail to earn a red token.

Testing and modeling of production of verbs in the active voice. It was possible that children would not produce a sentence in the passive voice because they did not use the verb in any sentence form. To eliminate this possibility, children were tested on usage of the verbs in the active voice.

The experimenter exposed one present tense picture for a particular verb and asked, "(Child's name), what's happening here?". If the child used the verb correctly in either the present or present-progressive tense, i.e. "The boy pushes the girl." or "The boy is pushing the girl.", the trial was scored as correct and the next verb was presented. If the child did not respond correctly or did not respond within five seconds, the experimenter modeled the correct response in the present tense and presented the next verb. This procedure was repeated until the subject made two consecutive correct responses for each verb. As this criterion was met for each verb, the verb was dropped from the sequence and modeling was continued for the remaining verbs. Each session included twenty-four trials requiring usage of the verb in the active voice and six labelling trials.

When criterion was met for each verb, the verbs were rank ordered by mean number of trials to criterion averaged across all subjects. The verbs with the greatest number of mean trials to criterion were selected as the stimuli for subsequent modeling; the verbs with fewest trials to criterion were selected as stimuli to test the generalization of modeling (probes).

Baseline of productive usage of the passive voice. Prior to modeling, baseline sessions measured the children's productive passive usage in both past and future tense for each of the verbs.

1. Future tense trials: The experimenter exposed one future and one present tense picture, pointed to a future tense picture, and said, for example, "(Child's name), here the boy will push the girl. What will happen to the girl? The girl. . ." No consequences were provided for the children's responses. The experimenter merely recorded the child's response and presented the next trial. If the subject failed to respond within five seconds, the experimenter prompted the child to respond, for example, "(Child's name), can you tell me what will happen to the girl?"

2. Past tense trials: The procedure was the same as that for future tense trials except that the experimenter exposed one present and one past tense picture, pointed to the past tense picture, and said, for example, "Child's name), here the boy has pushed the girl. What has happened to the girl? The

girl. . .".

During each session twelve future tense and twelve past tense trials were presented, randomly intermixed.

Modeling productive usage of the passive voice. After the baseline of productive passive usage was measured, modeling of this usage was begun in either the future or the past tense. Across all children two forms of each tense were modeled, but each child experienced modeling of only one form of each tense. The two future tense forms modeled were "shall be" and "will be"; the two past tense forms, "was" and "has been". After criterion was met on the first tense modeled, the second tense was modeled to criterion, and finally both tenses were concurrently modeled.

1. Future tense trials: The experimenter exposed one future tense and one present tense picture, pointed to the future tense picture, and said, for example, "(Child's name), here the boy will push the girl. What will happen to the girl? The girl. . .". (As the children began to respond appropriately, "The girl. . ." was faded out, so that the children responded to the question alone.) When the subject made an incorrect response or no response within five seconds, the experimenter modeled, "The boy will be (shall be) pushed. The boy. . .", and recorded the child's responses both before and after the model. A response was defined as incorrect and was subsequently modeled if any of it's components were missing, e.g., "The boy will be push(ed)." or given in the incorrect order, e.g., "Will be pushed, (the boy)." Before the prompt, ". . .The boy. . ." was faded out, a response which did not include these two elements was not considered incorrect. No consequences were provided for correct responses.

2. Past tense trials: The procedures were the same as for future tense trials except the experimenter exposed one present and one past tense picture, pointed to the past tense picture, and said, for example, "(Child's name), here the boy has pushed the girl. What has happened to the girl? The girl. . .".

When the subject made an incorrect or no response within five seconds, the experimenter modeled, "The boy has been (was) pushed. The boy. . .".

During all modeling conditions trials were presented in random order, with the exception that verbs were presented in pairs. Each verb was first presented with one agent and receiver of the action and presented on the next trial with the agent and receiver of the action reversed, e.g., if on one trial the experimenter exposed two pictures from the top half of the page and asked, ". . .What has happened to the girl?", on the immediately following trial he exposed two pictures from the bottom half of the page and asked, ". . .What has happened to the boy?".

When one tense was being modeled a session included twenty-four modeling trials (six verbs presented four times each) and six labelling trials. When two tenses were being concurrently modeled a session included twelve future and twelve past tense trials (six verbs of each tense presented twice each) as well as six labelling trials.

Probing productive usage of the passive voice. Probe sessions were conducted after a specified criterion was met on a previous modeling or probe session. In a probe session, previously modeled verbs were interspersed with unmodeled (probe) verbs of both future and past tense.

The procedures for trials on which previously modeled verbs were presented were the same as those used in modeling sessions with the exception that ordering of trials was random (i.e., verbs were not presented in pairs as was done during modeling sessions). The procedures for trials on which probe verbs were presented were the same as those used in baseline with the exception that the child was given only one opportunity to respond, i.e., if no response was made, the child was not prompted to respond.

Probe sessions were of two types: Probe I sessions occurred during an experimental condition where one tense was being modeled and consisted of eight modeling trials (of the tense being modeled), eight probe trials of the same tense, eight probe trials of the tense not modeled, and six labelling trials; Probe II sessions occurred during an experimental condition where both tenses were being concurrently modeled and consisted of twelve modeling trials (six past and six future tense), twelve probe trials (six past and six future tense), and six labelling trials. Trials were presented in random order. The verbs used on both modeled and probe trials are presented in Table 1.

Scoring of Responses and Reliability

During several modeling sessions and almost all probe sessions, an observer and the experimenter simultaneously recorded the children's responses. The observer was located in an observation room adjacent to the experimental room, and viewed the experimental room through a one-way window. An intercom connected the two rooms so that the observer could hear what was said in the experimental room. The back of the experimenter faced the observer, and the experimenter's score sheet was positioned in front of the experimenter such that it could not be seen by the observer.

In recording responses, both the experimenter and observer used a check sheet, checking a box to indicate the presence of each component. If an incorrect auxiliary was used, they recorded what auxiliary was used.

Because of difficulty in obtaining observer agreement as to whether the "ed" inflection did or did not occur on some responses, the definition of responses scored as correct on both modeled and probe trials differed from the definition of a correct response used by the observer in judging whether a model should be provided (on modeled trials). For purposes of modeling, all components of the response must have occurred in the appropriate order (as described earlier). For purposes of scoring a response as correct, the same definition was used with the exception that the "ed" inflection on the verb need not have occurred.

Because consequences were provided for some modeled trials during both modeling and probe sessions (and, thus, may have affected the observers scoring of those trials) only the percentage of observer agreement on probe trials is presented. These data include all probe sessions during which the experimenter and observer simultaneously scored responses. An agreement was counted if both the experimenter and observer agreed that a response was correct or that it was incorrect. The percentage of observer agreement was obtained by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. The percentages of agreement for each subject are: Stan, 98%; Lynne, 99%; Bertha, 92%; and Anna, 95%.

Experimental Design

The experimental design involved the manipulation of two baselines: that of productive future tense passive usage, and that of productive past tense passive usage. The experimental sequence was as follows: (*a*) Testing and modeling of productive active usage, (*b*) Baseline of productive passive usage, (*c*) Modeling productive passive usage of one tense, (*d*) Modeling productive passive usage of the second tense, (*e*) Modeling productive passive usage of both tenses concurrently.

During experimental conditions in which passive usage was modeled, probe sessions were conducted after each modeling session on which 80% of the modeling trials were correct or after eight sessions were conducted in which the 80% criterion was not met. (A productive probe was also conducted prior to the end of each preschool semester whether or not criterion was met.) If, on this probe, 80% of the probe trials of the tense being modeled (the future tense probe trials if the future tense was being modeled; both past and future tense probe trials if both forms were being modeled) were correct, a second probe was conducted. If the 80% criterion was not met on either probe, modeling sessions were continued until the 80% criterion was again met during modeling or eight sessions were conducted. The criterion for changing experimental conditions was 80% correct responses on probe trials of the tense being trained for two consecutive probe sessions.

RESULTS

The data for each subject are presented in Figures 2, 3, 4, and 5. The top portion of each figure presents the per cent of correct responses on modeled trials during both modeling and probe sessions. The bottom portion of each figure presents the per cent of correct responses on probe trials during the probe sessions.

The data for Stan are presented in Figure 2. Stan met criterion rapidly on modeled trials (during the first modeling session) when the past tense was modeled (top set of axes). He also met criterion during probe sessions immediately, displaying 100 per cent correct past tense usage on unmodeled probes (bottom set of axes). However during this first modeling condition, future tense usage on the probes remained at zero. In the second modeling condition, when the future tense was modeled, past tense usage on probes returned to its baseline level while correct future tense usage on probes increased to 100%. When both tenses were modeled concurrently in the third modeling condition, Stan's correct past and future tense usage on probe trials was initially not perfect, but both correct past and future tense usage on probe trials was at 100 per cent during the final probe.

The data for Lynne are presented in Figure 3. Due to the change in criteria described earlier, Lynne met criterion twice during modeling sessions of the future tense without receiving a probe session (top set of axes). These sessions occurred between the initial and final probes conducted during this condition. During the first probes of the first modeling condition, the level of correct future tense usage on probe trials was low, but increased to nearly

90 per cent on the final probes of this condition (bottom set of axes). Past tense usage on probe trials remained at its baseline level. In the second modeling condition, when the past tense was modeled, correct past tense usage on probe trials increased from 50 per cent on the initial probe to 100 per cent during the final probes. Correct future tense usage on probe trials returned to its baseline level. In the third modeling condition, when both forms were modeled, correct past tense usage on modeled trials declined to the zero level and suddenly increased to 100 per cent (top set of axes). This reversal occurred during the first session conducted after a 2½ month period during which no experimental sessions were conducted. The experimenter was also changed at this time. Future tense usage steadily recovered to the level observed when future tense was modeled. On the first probe conducted during this condition, Lynne's past tense usage on probe trials was at the baseline level; future tense usage had increased to 67 per cent (bottom set of axes). During the final two probes both past and future tense usage were at 100 per cent.

Figure 4 presents the data for Bertha. In the first modeling condition, Bertha met criterion during modeling of the future tense only after forty-one sessions (top set of axes). The percentage of correct responses on future tense probe trials increased steadily over successive probes to 88 per cent and 75 per cent on the final two probes (bottom set of axes). Past tense usage remained at the baseline level. Although future tense usage on the final probe was not at criterion level, due to a shortage of time, past tense modeling was begun. During this second modeling condition Bertha's past tense usage on probe trials reached criterion during the fifth probe. In contrast to the first two children described whose usage on probe trials entirely reflected the form being modeled, Bertha's future tense usage on probe trials increased from the level observed when the future tense was modeled.

The data for Anna are presented in Figure 5. During modeling of the past tense, this child's correct past tense usage on modeled trials increased only slightly from its baseline level (top set of axes). Her correct past tense usage on probe trials did not increase at all from baseline (bottom set of axes). After the second probe, Anna was given the option of exchanging her tokens at the conclusion of each session, as had been done previously, or of saving them for a number of sessions and exchanging them for a larger toy. When this change was made, Anna's past tense usage on modeled trials increased to 88 per cent. During a probe conducted at this time Anna's past tense usage on probe trials was 63 per cent. After this session, a two month period occurred in which no experimental sessions were conducted. When sessions were resumed with a new experimenter, Anna's past tense usage returned to its previous low level, and sessions were terminated.

Table 2 shows, for each probe session, the percentage of overgeneralization of responses (i.e., the percentage of trials on which the child used the past tense on future tense probe trials and the percentage of trials on which the child used the future tense on past tense probe trials). For Stan and Lynne, when one tense was modeled, the amount and type of overgeneralization was highly correlated with the form being modeled. For Bertha and Anna, no consistent relationship was apparent.

In summary, three of the four children (Stan, Lynne, and Bertha) exposed to modeling contingent on incorrect responses used the tense currently being modeled on unmodeled probes of that tense. One child, Bertha, used both tenses appropriately on probes after both forms had been modeled sequentially; two children, Stan and Lynne, used both tenses appropriately on probes only after both tenses were modeled concurrently. The fourth child, Anna, did not use the tense modeled in the initial experimental condition, and modeling was discontinued. On incorrect trials all four children exhibited nearly 100 per cent correct usage after the model was provided.

DISCUSSION

The performance of three of the four children indicates that modeling of appropriate usage contingent upon errors can increase generative productive usage of the passive voice in normal preschool children. This appropriate generative usage occurred in experimental conditions where one tense was modeled alone and where both tenses were modeled concurrently.

In addition to appropriate generalization (of the tense modeled to unmodeled stimuli of the same tense), the children also exhibited inappropriate or over-generalization of the tense modeled to unmodeled stimuli of the other tense, e.g., to the question "What has happened to the girl?", children answered, "The girl will be pushed." on past tense probe trials when the future tense form, "will be", was modeled. This inappropriate generalization occurred not only when the first tense was modeled alone, but also when the second tense was modeled alone. (The latter was not true of Bertha who discriminated both tenses after both had been modeled sequentially.) Thus, in two of the three children for whom modeling was effective, current modeling conditions caused a decrease in appropriate usage of a form which had previously been used correctly. For these two children discrimination of both tenses was not exhibited until both forms were modeled concurrently.

These findings correspond closely to results of previous research with speech deficient children (Guess, Sailor, Rutherford & Baer, 1968; Guess, 1969; Sailor, 1969; Schumaker & Sherman, 1970). The present research differed from these earlier studies in several respects: 1) normal preschool children rather than speech deficient children were used as subjects; 2) the language class modeled was more complex than those previously trained (Chomsky, 1957); 3) stimulus items were presented concurrently rather than sequentially (in previous studies children met criterion on one stimulus item, then a second and third, and so on); and 4) whereas previous procedures involved both modeling and differential reinforcement for appropriate usage, the present procedure did not include the latter. The children involved in the present research were not reinforced for imitating the experimenter at any time during the course of the experiment. Thus, while the implications of the present findings for the language of speech deficient children are unknown, the present study extends the generality of the research with speech deficient children by again exposing children to a set of procedures such that their resulting language extends beyond that which has been directly modeled or trained.

The present findings also correspond to the results of previous research with normal grade school children. In these studies it was found that, in some cases, modeling without differential reinforcement can result in language usage which corresponds to a modeled form but which extends beyond that which was modeled. (An exception is the study by Harris and Hassemer (1972) which examined the effects of modeling on sentence complexity rather than a particular form, and which did not examine generalization to novel stimuli.) Examined collectively, these studies present somewhat conflicting results: Bandura and Harris (1966) found no increased usage of either prepositional phrases or passive voice constructions as a result of modeling alone. Modeling with reinforcement and instructions was more effective than reinforcement and instructions in increasing passive usage, but not prepositions. Rosenthal and Whitebook (1970) found effects as a result of modeling, but these were confounded with effects of incentives and instructions. Three studies (Harris & Hassemer, 1972; Lahey, 1971; and Malouf & Dodd, 1972) have reported modeling alone as effective in changing the language usage of young children. Of these, only Malouf and Dodd reported increased usage of examples of a "rule" which had not existed in their subjects' repertoires prior to training.

The reasons for these conflicting findings are unclear, and may lie in the procedures or subjects used, the language form examined, or any of a number of other variables. In this context, the present study must be interpreted in terms of the degree to which it varies from previous research. With some notable exceptions, the procedures and the response class used in the present study are similar to those of Malouf and Dodd. In their expansion condition, a response which the children had not previously exhibited was modeled until some criterion was met, and the children's generative usage of this response was subsequently examined. Their procedure differed from that of the present study in that the correct form of the response was modeled after every response rather than only after errors and in that presentation of stimuli was automated rather than presented by a human experimenter.

The present study differed from those of Bandura & Harris, Rosenthal & Whitebook, Harris & Hassemer, and Lahey in several respects: 1) preschool rather than grade school children were used as subjects (Lahey used disadvantaged preschool children); 2) the response modeled was one which the children did not exhibit during extensive pretesting and which probably did not exist in their repertoires; 3) modeling occurred contingent upon incorrect responses rather than prior to the child's opportunity to respond; 4) modeling was continued until a criterion was met (or until the child exhibited no change across three probes) rather than for a fixed number of trials.

The way in which the present findings relate to children's acquisiton of language in the normal environment is speculative. It has been observed that parents occasionally "expand" their young children's utterances by filling in missing grammatical functors (Brown & Bellugi, 1964; Brown, Cazden, & Bellugi, 1969). But whether these expansions serve a function in the child's acquisition of language is, as yet, unknown (Cazden, 1965; Feldman, 1971). Further, even though Malouf and Dodd used the term "expansion" to label a procedure in which a correct response was modeled contingent upon each trial (regardless of the child's response), this label may be disputed. Brown & Bellugi (1964) cited the mother's preservation of the child's word order in her expansions of his utterances. Thus, their use of the term "expansion" is dependent on the form of the child's utterance as well as that of the model which is subsequently presented. This, coupled with the fact that expansions which have been observed in the home occurred only occasionally and presumably only after children's spontaneous (unprompted) utterances would seem to indicate significant differences in usage.

Even though the procedures used in the present study may roughly correspond to mother-child interaction in the natural invironment, the present findings must be qualified in various ways. The modeling conditions were lengthy; it is doubtful that a child in the natural environment experiences such lengthy or concentrated training (Schumaker & Sherman, 1970). It is possible, however, that the child may encounter a similar number of models of the passive voice construction enroute to his mastery of that form. Secondly, because pictures only of the tense involved on a particular trial (and the present tense picture) were presented on that trial, coupled with the experimenter pointing to the referent, it is possible that children's responses were controlled by the picture presented rather than by the experimenter's question. This possibility was not examined, but could easily have been done by presenting the children with pictures of both tenses modeled, and by eliminating experimenter pointing. Finally, the results must be qualified by the fact that one of the four subjects did not exhibit increased usage of the passive voice with the procedures used. The reason for this failure is not readily apparent. It has been noted that this child conversed solely in Spanish in her home; she also verbalized very little in her preschool classroom. The child's level of English syntax may have been such that she lacked necessary prerequisites for passive usage (if there are such prerequisites). On the other hand, the "reinforcers" supplied may not have acted in this capacity. One indication that this may have been so was the brief increase in her passive usage when she was given the opportunity to save her tokens and exchange them for a larger toy than those previously obtainable.

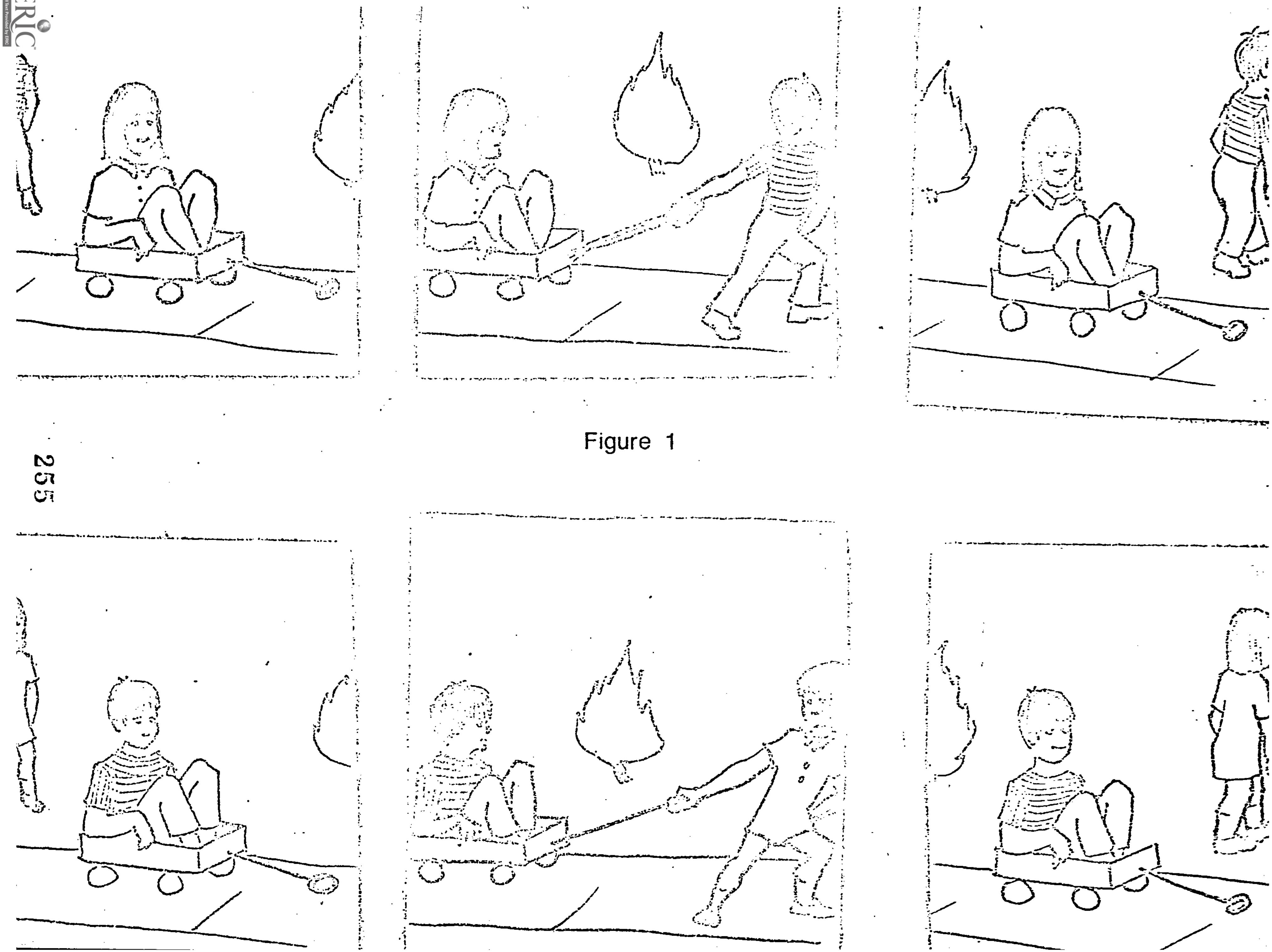

Figure 1

Figure 2. Stan

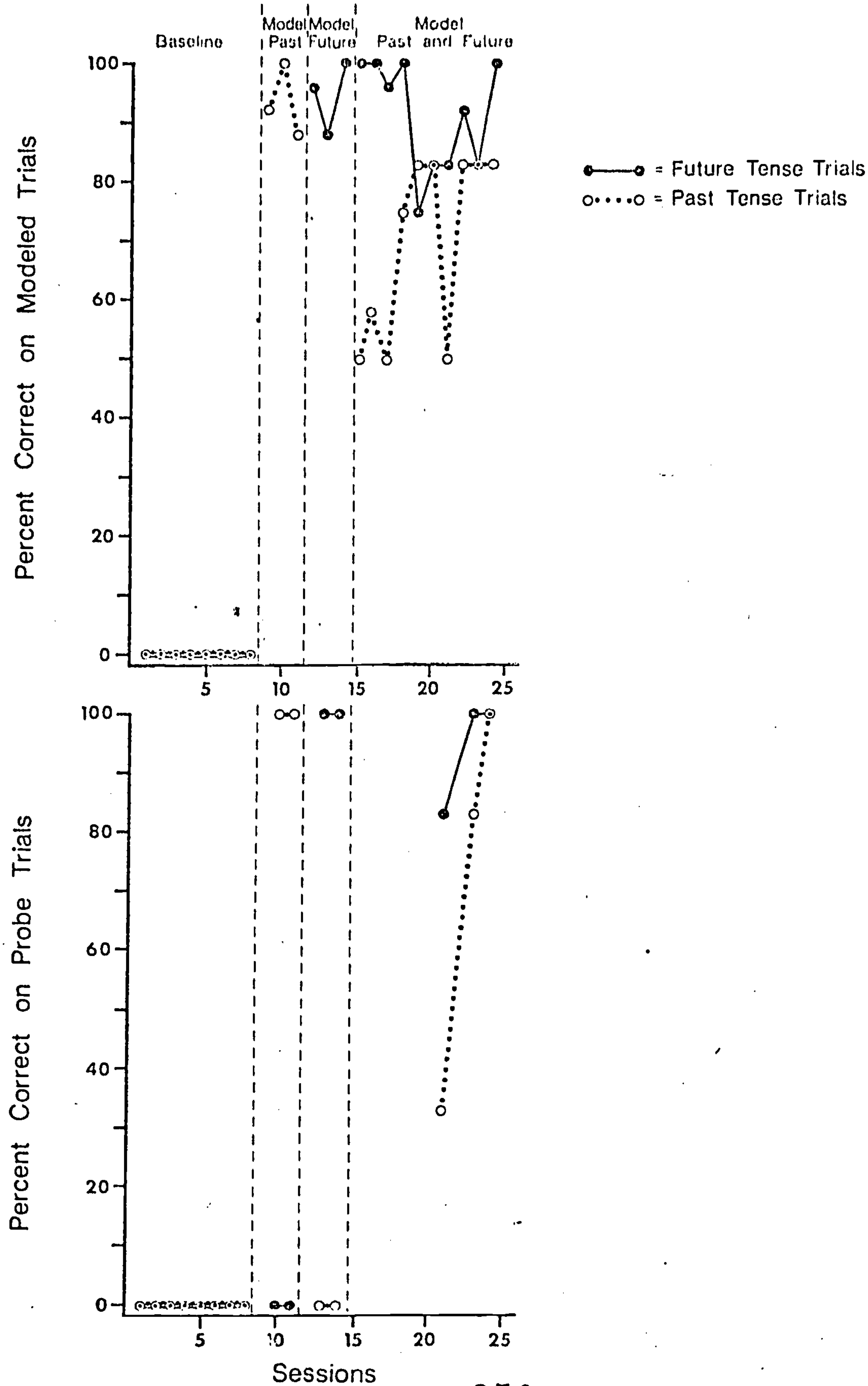

Figure 3. Lynne

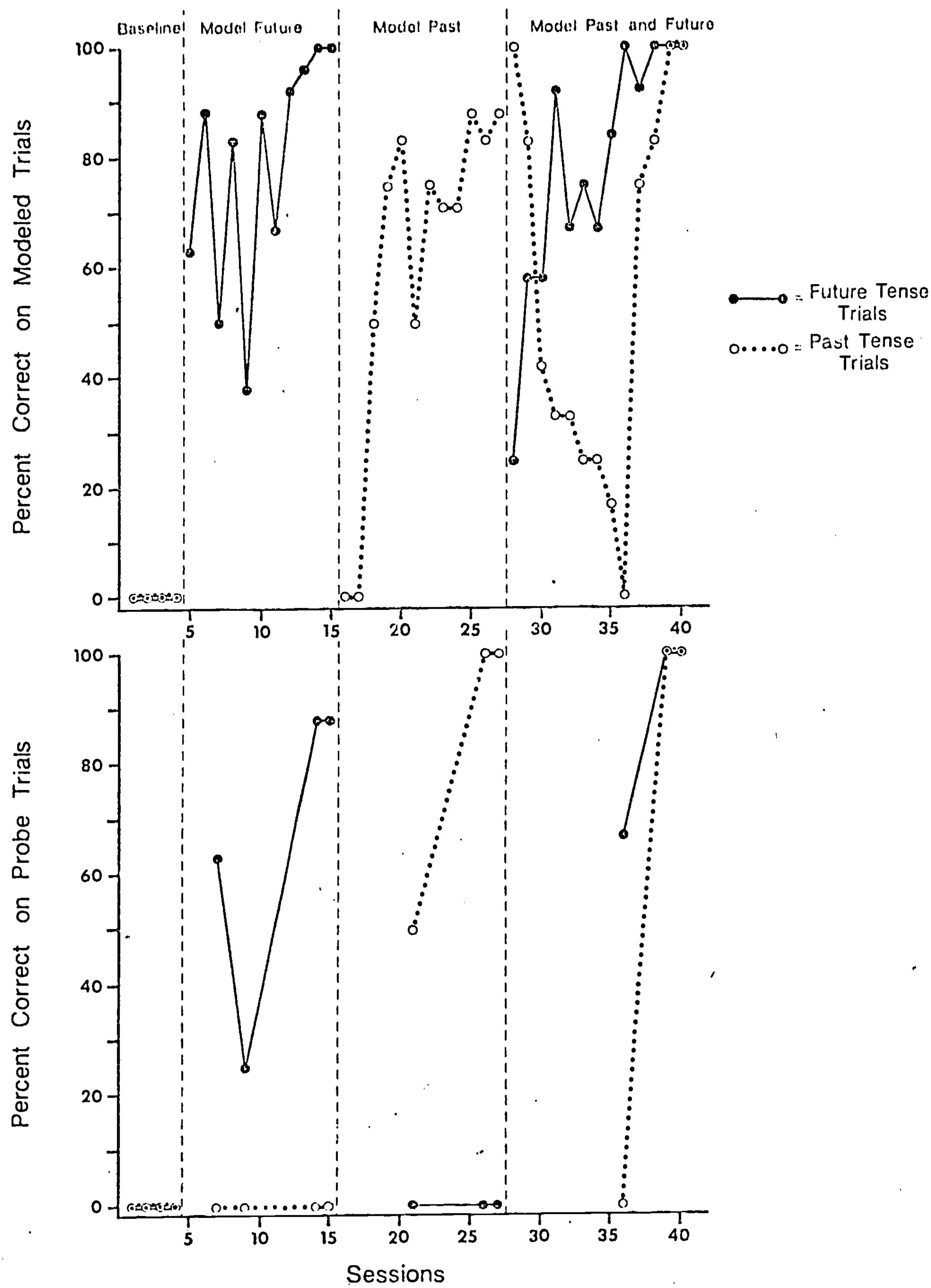

Figure 4. Bertha

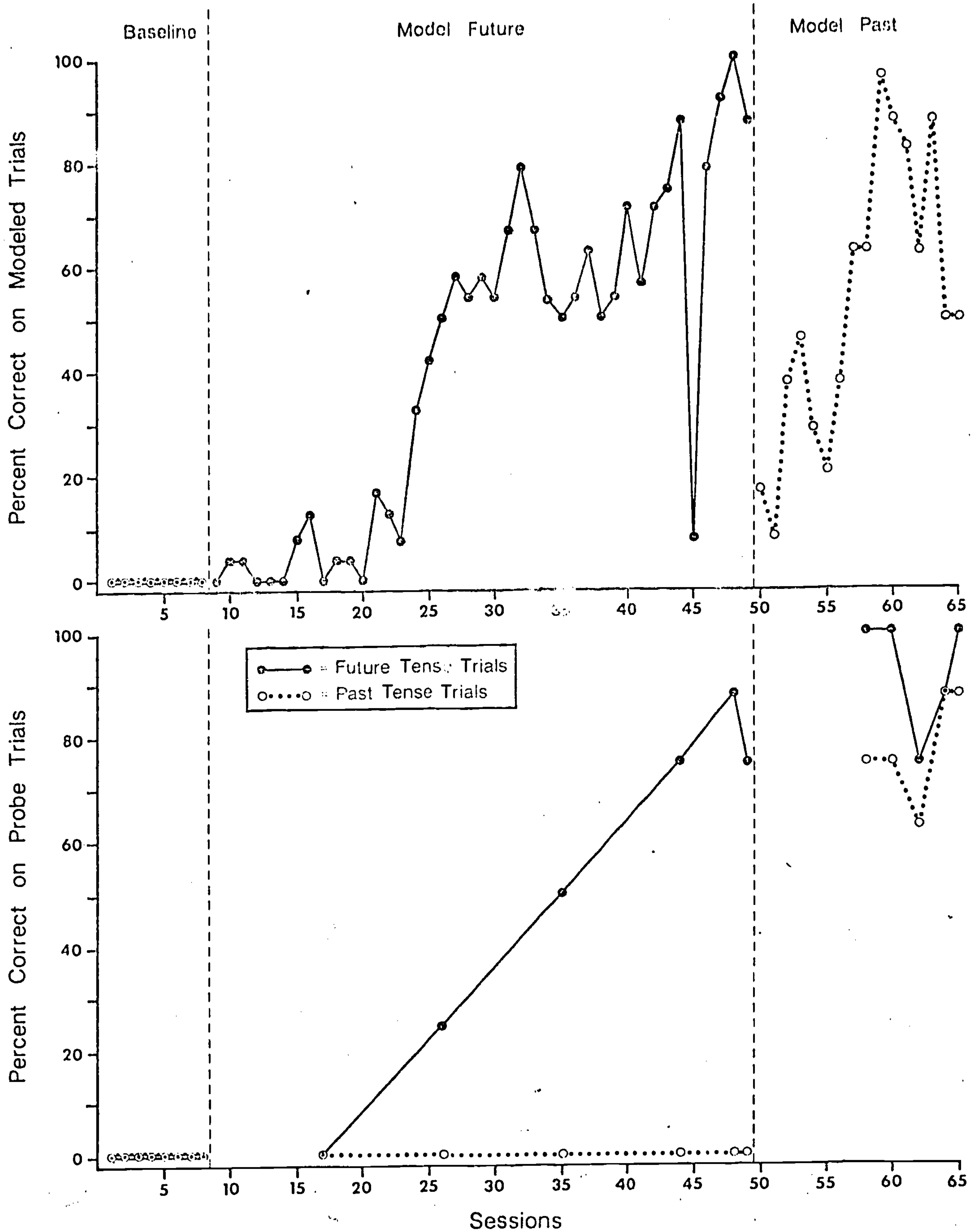

TABLE 1*

	Modeled verbs	Probe verbs
Set I:	Hug	Pull
	Row	Crown
	Splash	Paint
	Kiss	Push
	Lift	
	Scratch	

	Modeled verbs	Probe verbs
Set II:	Pull	Hug
	Lick	Jump
	Cover	Wash
	Rub	Spray
	Lift	
	Scratch	

*For all children, the modeled verbs in Set I were modeled in the initial modeling condition. Thus, if the future tense was modeled first, the probe verbs of Set I were used to probe future tense usage.

TABLE 2

Percent Overgeneralization on Probe Trials

Child	Successive probes:	1	2	3	4	5	6	1	2	3	4	5	1	2	3
	% Overgeneralization of	Experimental condition													
Stan		Past tense modeled						Future tense modeled					Both modeled		
	Future tense to past tense probes:	0	0					88	88				50	17	0
	Past tense to future tense probes:	100	100					0	0				0	0	0
Lynne		Future tense modeled						Past tense modeled					Both modeled		
	Future tense to past tense probes:	38	13	100	100			0	0	0			83	0	0
	Past tense to future tense probes:	0	0	0	0			63	100	100			0	0	0
Bertha		Future tense modeled						Past tense modeled							
	Future tense to past tense probes:	0	38	25	75	75	88	13	0	38	25	13			
	Past tense to future tense probes:	0	0	0	0	0	0	0	0	13	0	0			
Anna		Past tense modeled													
	Future tense to past tense probes:	0	0	0	0										
	Past tense to future tense probes:	0	0	25	0										

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FY 1972

December, 1972

Project:	Infant Day Care Research
Prlject Code No.:	IHOK10
Principal Investigator:	Todd R. Risley
Contents of this report:	K10-2 Progress Report
	The Across-Environment Evaluation Procedure
	Across-Environment Evaluation Measures and Data Gathering Procedure

KANSAS CENTER FOR RESEARCH IN EARLY CHILDHOOD EDUCATION

Project No. 1HOK10-1

INFANT DAY CARE RESEARCH

Progress Report
December, 1972

Principal Investigator

Todd R. Risley
University of Kansas

Program 3
Component G

PROGRESS REPORT

Infant Day Care Research

Component G Resume

Program 3

The Kansas Center for Research in Early Childhood Education:
Analysis and Modification of the Acquisition of Social and
Intellectual Behaviors

Being almost midway in the five year Day Care Program plan of research, we have taken this opportunity to review our progress. As described in the original five year plan we have to date:

1. Established an Infant Day Care Program for children one month to twelve months of age;

2. Established a Toddler Day Care Program for children twelve to thirty months of age;

3. Designed a research measure to determine the quality of care provided by the program;

4. With additional support from the U.S. Office of Education, administered directly from the National Program on Early Childhood Education, we are completing a series of staff training manuals detailing the operation of the Infant and Toddler Centers.

In addition we have found that a necessary part of this work includes two areas which were not formally specified as products in the original proposal:

5. A series of studies empirically investigating issues in day care practice;

6. The development of procedures for assessing the quality of care provided in other day care environments.

The following section will elaborate our progress in these six areas.

Infant Center

Work at the Infant Center has focused on the design of facilities, materials, and staff routines, to make the care of groups of infants safe, efficient, and economically feasible. To insure that infants in a group child care situation receive the same quality of care that they could receive at home, the program is designed to meet each child's individual schedule. This means that while some infants are to be fed, at the same time others must be diapered, put down for a nap, or engaged in play and exploration. We have found that by the careful distribution of staff in the various areas of the center, as well as the modification of existing child care equipment, five caregivers can provide this level of care for as many as twenty infants, thus making group care cost effective.

Toddler Center

In the Toddler Center we have extended our investigation to the next stage of child development. At this age, children begin to walk well, move around rapidly, engage in active play, and begin playing together. Their behavior is similar to that of preschoolers, but lacks the level of skill exhibited by the older children. Toddlers also sample different types of foods, and are able to begin acquiring self-help skills. The specific procedures developed at the Infant Center are not adequate to meet these children's needs. Therefore, work at the Toddler Center has not only tracked the progress at the Infant Center, in terms of developing safe, efficient facilities and routines, but has also focused on procedures for play activities, self-toileting, self-feeding, food preferences, and napping. The Toddler Center will soon be expanded to provide care for as many as 20 children with 4 caregivers, thereby working toward a cost-effective day care program.

Program Evaluation

Initially, from the daily operation of the Infant Center, we have designed a research measure to determine the quality of care provided by our program. A complete description of this measurement tool and preliminary results of its application are reported in the Infant Day Care Research 1972 Progress Report.

Staff Training Manuals

We are developing and testing a series of staff training manuals for each of the necessary functions of a day care program. These manuals detail the arrangement of staff duties incorporating standards for care and design of facilities. The manuals are tested on their adequacy as instructional materials by having untrained people perform the specified child care routines solely on the basis of the instructions in the manuals. Their performance is assessed and the manuals revised until untrained staff can perform up to our standards for level of care.

Research

Concurrent with developing and formalizing specific day care procedures, we have been empirically investigating the effectiveness of specific day care practices. That is, some of the more important child care practices, already in use at day care centers are subjected to experimental analysis in order to demonstrate their effectiveness in terms of quality care and economic feasibility. For example, feeding is always an important yet busy time of the day. Our research has shown that the use of a large display board of children's feeding schedules can significantly aid staff in meeting children's feeding schedules. Another important consideration in feeding is the way in which children are fed. In a group care situation, children can either be fed by staff in a small group or one at a time. In the latter case more individual attention may be possible but in order to feed all children on schedule extra staff need to be employed. In the individual one-staff-to-one-child situation children can be either held or seated while being fed. On the other hand, when children are fed in a small group they will all need to be seated. At present we are investigating the relative advantages and disadvantages of each feeding situation. We are empirically examining the effects of being seated or held on such dependant variables as infants' crying, the amount of food consumed, and the amount of time spent eating. These and other studies have helped us evaluate our procedures in terms of both quality of care and economic feasibility.

General Day Care Evaluation

The final area we want to review, has been the focus of the last 6 months work.

The Infant Day Care Research, 1972 Progress Report stated "During the second six month period we will concentrate our efforts on extending our evaluation proceedings to include the preliminary development of a measurement tool for assessing day care homes as well as day care centers."[1] Accordingly, we have continued to refine across-environments evaluation procedures which will reliably detect differences in the level of care children receive in day care homes and centers. The major thrust

[1]The preliminary findings of pilot research which served as an impetus for the current direction of our work has been described in the previous report and is here presented in Appendix A.

of the past six months research has been in establishing the reliability of this evaluation. Work has focused on determining procedures and behavioral descriptions necessary for obtaining high reliability between observers.

Specifically we have measured the behaviors of both the children and adults in a variety of child care settings. The behaviors measured included speech, children's and adults' interaction, play materials, and physical contact between children and children, and adults and children. A complete description of these measures and manner of data collection appears in Appendix B.

Reliability estimates of these measures were obtained in five settings: the Infant Day Care Center, the Toddler Day Care Center, two day care homes, and an institution for retarded children. The focus of these observations was to determine if the same measures could reliably record behavior in different settings, using different observers. Three observers took these measures. At any one time, two of these observers took the data simultaneously but independently, and a percentage score of their agreement was computed.

Table I shows the reliability scores for all measures averaged for each setting. As can be seen, reliability ranged from 81.7 - 92.5% with a mean of 85.3%.

TABLE I

Reliability scores for across-environments measures averaged for each setting.

Infant Center	85.8
Toddler Center	81.7
Day Care Home A	92.5
Day Care Home B	84.2
Retardation Institution	82.9
Average	85.3

We found some interesting differences with regard to the reliability of the various measures across environments.

Some measures were more reliable more often in certain settings than in others. For example, "adult speech to children" was more reliable at the day care homes and the Toddler Center, than at the Infant Center and the residential institution for retarded children. Another measure "children's interaction with objects" was equally reliable across all the settings. However, "child speech" was quite unreliable across all the settings. Physical contact between adults and children was a more reliable measure than physical contact among the children. Differences in the physical characteristics of the settings and the topography of the behaviors may account for the differences in reliability. For example, it was usually noisier at the Infant Center, which may account for the fact that it was harder to measure adult speech to children. The topography of child speech is quite different from adult speech, and this may result in lower reliability with child speech.

Physical contact between an adult and child usually took the form of holding the child and leading him by the hand, whereas such contact among the children more often consisted of brushing against the child while running, or sitting closely while playing. It may be easier to see some behaviors than others.

Research on this aspect of the Day Care Program has led to three avenues for future work. First, we will be further refining procedures on those measures demonstrating less than acceptable reliability. Second, having determined the accuracy of these measures across environments, we are currently analyzing the data to determine which type analyses will permit conclusions to be made about differences in the level of care available in various settings. Third, as differences between settings are encountered, we will be formalizing procedures for incorporating aspects of quality care. For example, in some observations in day care homes, we have found that the mothers were on more intimate terms with the children than were the Staff at our Day Care Center. That is, they hugged, kissed and smiled at them more. Thus, at the Toddler Center we are attempting to apply what we have learned by observing the child care children receive in day care homes. Specifically, we are investigating how such "affection" might be increased in a day care center setting. Currently, we are looking at this during a limited period of the day. In the Toddler Center we have set aside one half hour each day for "affection time". At this time all the toys are put away and the staff and children hug each other, tumble, exercise and sing. Our preliminary observations indicate that not only is this activity well received, but the specific behaviors of affection by both staff and children are beginning to generalize to other periods of the day.

APPENDIX A

The Across-Environment Evaluation Procedure

from 1972 Progress Report

Infant Day Care Research

Component G Resume

Program 3

Across-Environment Evaluation Procedure

The following paragraphs describe our progress in developing an across-environment evaluation procedure and some of our preliminary results.

Measures were taken on child and staff behavior at three day care settings for 35 days, 45 minutes each day. These settings included the Infant Day Care Center located in Lawrence, Kansas, operated in cooperation with the National Program on Early Childhood Education, and two day care homes also located in Lawrence, Kansas, run by private home owners. Children and staff at the Infant Day Care Center who were observed during this period included 10 to 12 infants between 1 and 12 months of age and four to five adults who cared for them each day. In the day care home operated by Mrs. S, each day she and usually two to three children aged 1 to 3 years were observed. In the other day care home operated by Mrs. Z, she and four to six children aged 2 1/2 to 5 years old were observed.

One of the behaviors observed was how often an adult talked to the children. Our preliminary data showed differences between the settings. On the average, the Infant Center staff talked to the children 26% of the time, Mrs. Z talked to the children in her home 43% of the time, and Mrs. S talked to the children in her home 69% of the time.

We also observed and noted differences in the amount of time adults in each environment spent in physical contact with the children, such as holding them or leading them by the hand. Mrs. Z did this an average of 30% of the time, while Mrs. S and the Infant Center staff averaged about 55%. However, an important point which can and should be made from such an across-environment evaluation is not only gross quantitative measures of the level of care but also more qualitative indices. For example, the data showed a difference between the Infant Center staff and Mrs. S on what they were doing with the children while in physical contact with them. The Infant Center staff were usually feeding or diapering while Mrs. S was usually doing other things such as hugging, playing games, etc.

An important difference we also noted was that Mrs. S was on more intimate terms with the children. In attempting to define and take objective measures on this casual observation of intimacy, we noted the number of times adults in each setting smiled at the children, touched their faces, and kissed them. The data we have collected to date indicate that one day care mother, Mrs. S, did these things more often: on the average, during a 10 minute period, Mrs. S would engage in these "mothering behaviors" 20 times; the Infant Center staff on the average during a 10 minute period would engage in these "mothering behaviors" 8 times; and Mrs. Z 5 times.

We also considered and measured several facets of children's behavior. One of these was toy play. No differences were found between settings; toy play in each setting averaged about 30%. However, the three settings differed in the amount of time the children spent interacting with each other while engaged in toy play. This included such behaviors as two or more children playing with the same toy, holding hands, etc. The data showed that the children at the Infant Center and at Mrs. S's home spent only 3% of their time engaged in group play situations. The children at Mrs. Z's, however, spent more time interacting with each other, about 13%.

A universally important measure is crying. Our preliminary across-environment evaluation measures have shown crying to be highest at the Infant Center, about 12% of the children's time. Comparatively, crying almost never occurred at Mrs. Z's. To look at the other side, we are currently working on a system to measure children's expression of happiness including such indices as smiling and laughing.

Of course, some of the differences we have noted in different environments may be attributable to the fact that children in one environment differed in age from children in the other environment. However, at this point we have found the measure to be equally reliable in all environments and to provide sufficient data to enable us to objectively measure and display differences in groups of children's behavior. We need to further refine our measurement procedures by developing and testing them in situations which compare the level of care provided in day care centers, day care homes, and by the parents in the child's own home.

APPENDIX B

Across-Environment Evaluation Measures and Data Gathering Procedure

Samples of data sheet for recording adult and child behavior. Each column of blocks represents one 5 second observation of one adult or child. The name is written at the top of the column. The observers watch the adult or child for 5 seconds. An X is placed in the box for each behavior displayed during the 5 second observation. If none of the behaviors occurred, an X is placed in the "None" box. The observers then observe another adult or child.

The behaviors recorded for adults are:

1. interaction with children, using objects;
2. verbalization to children;
3. physical contact with children.

The behaviors recorded for children are:

1. interaction with objects;
2. verbalization;
3. physical contact with adults;
4. physical contact with children.

	Name	Name	Name	Name	Name
Interaction with children, using objects					
Verbalization to children					
Physical contact with children					
None					

Sample data sheet for recording adult interaction with children. Each column of blocks represents one 5 second interval of observation.

	Name	Name	Name	Name	Name
Interaction with objects					
Verbalization					
Physical contact with adults					
Physical contact with children					
None					

Sample data sheet for recording child interaction with adults and other children. Each column of blocks represents one 5 second interval of observation.

Description of the measures used to record <u>adult</u> interaction with children. The observers read these decriptions, before entering the day care setting, and referred to them if necessary during the observation session. The measures include:

Interaction with children using objects
Verbalization to children
Physical contact with children

ADULT INTERACTION WITH CHILDREN - OBJECTS

This is one of the behaviors that could occur during the 5 second interval you are observing an adult.

Determine if the adult was interacting with a child by using an object for any part of the 5 second interval.

An object is defined as everything except: (this list is exactly the same as that for "Child Interaction with Objects")

Walls, windows, floors, rugs, curtain and drapes (unless hung specifically for children's play);
Furniture (couches, chairs, tables, beds, lamps, stoves, refrigerators, etc.);
Pacifiers;
Food and Eating utensils when child is in an eating situation;
Clothes the child or others are wearing (except dress-up clothes).

Here are some examples of objects: (this list is exactly the same as that for "Child Interaction with Objects")

toys, pens and pencils, paper, books, ashtrays, piece of dust, flowers, dirt, sand, water hose, food and eating utensils in a play situation (such as a tea party or scooping sand), boxes, tunnel toys, clothing not being worn by anyone, pets, rocks, acorns, grass, brooms and mops, blocks, watches, jewelry.

An adult is interacting with a child by using an object if she was doing something with an object that involved a child immediately, such as handing him an object, playing with an object with him, reading a book to him, showing him something, or verbally directing him to use an object. The child must be involved in the interaction. If an adult is picking up toys by herself, riding a bike herself, or reading to herself, it would not be considered interaction with children.

Mark an X in the "Ad. Obj" box on the data sheet if the adult interacted with a child using an object. Leave the space blank if he did not.

Try to get close enough to see what the adult is doing before you begin the observation.
Here are some examples of adult interaction with children using objects. This is not an exhaustive list but a reference.

- The adult shows a child an object;
- The adult demonstrates how an object works to children;
- The adult repairs an object for a child;
- The adult points to an object for a child to name;
- Helps child onto an object (swing, tricycle, wagon, etc);
- Hands child an object;

- Throws child an object;
- Turns on radio, phonograph, TV for child;
- Touches the same object as a child;
- Tells child to use an object in a particular way;
- Playing a game of cards or board game with child;
- Spinning a top for a child;
- Demonstrating cake-making to children;
- Holding an object in front of child's face;
- Showing child how to blow a whistle;
- Holding book open for child to see;
- Showing child how to play the piano, beat a drum, color, cut with scissors, paste, etc.
- Pushing child in a swing, holding handle of bicycle child is on;
- Helping child lift an object;
- Pulling a toy back and forth before child;
- Helping child pick up toys;
- Setting up painting equipment for a child;
- Taking objects off a shelf for child's use;
- Giving these types of verbal directions regarding objects:

  "Pick up the ball"

  "Come down that slide"

  "Go get on that swing"

  "Color in the lines"

  "Don't put paste on the furniture"

  "Help me put the toys away"

"Stack this block on that one"

Remember, the adult does not have to be touching an object. Sometimes she may just instruct in its use.

The following behaviors are not counted as adult interaction with children using objects:

- Handing food to a child;
- Fixing a child's clothing, wiping his nose, etc.
- Placing child on furniture;
- Looking out window with child;
- Giving or taking away a pacifier;
- Making statements about objects that don't involve getting the child to do something with an object, i.e. "that's pretty".

ADULT VERBALIZATION TO CHILDREN

This is one of the behaviors that could occur during the 5 second interval you are observing an adult.

Determine if the adult verbalized in some way to a child for any part of the 5 second interval.

Verbalization includes talking to, singing to, laughing at, making nonsense sounds to a child.

Mark an X in the "Verb" box on the data sheet if the adult verbalized to a child. Leave the space blank if she did not.

Try to get near enough to the adult before you begins the observation so you can hear if she speaks softly. Try to keep her face in view.

Sometimes people may speak very soft words or sounds to babies or small children, so be alert! Don't expect all adult verbalizations to children to be loud and clear. You do not have to understand what was said to the child to make an X.

Do not mark an X if the adult made any verbalizations to another adult or to herself.

ADULT PHYSICAL CONTACT WITH CHILDREN

This is one of the behaviors that could occur during the 5 second interval you are observing an adult.

Determine if the adult was physically in contact with a child for any part of the 5 second interval.

The adult is in physical contact with a child if any part of the adult's body touches any part of the child's body. The adult or child can initiate the contact, or the beginning of the contact could have occurred before your observation began. If the adult is hitting the child, do not record this as physical contact.

Mark an X in the PC box on the data sheet if the adult is in physical contact with a child. Leave the space blank if she is not.

Try to get close enough to see what the adult is doing before you begin the observation.

It is easy to see when an adult is holding or picking up a child, but be alert for instances of bodies brushing against each other for a second, or an adult's foot touching a child's foot.

ADULT PHYSICAL CONTACT WITH CHILDREN

Here are some examples of physical contact. This is not an exhaustive list, just a reference you can use to judge what you see.

- An adult is holding and feeding a child;
- An adult is touching a child's leg while changing his diaper;
- Rocking a child to sleep;
- A child crawls to an adult and lays a hand on her leg;
- A child hugs an adult;
- A child kisses an adult;
- An adult picks up a crying child;
- Patting a child on the head;
- An adult and child are sitting on a porch swing with their bodies touching;
- Adult and child are playing ring-around-the-rosie and holding hands;
- Adult places a child in the swing;
- Adult washes child's face;
- Tickling child;
- Removing a child physically from a dangerous situation .

Description of the measures used to record child interaction with adults and other children. The observers read the descriptions before entering the day care setting, and referred to them if necessary during the observation session. The measures include:

Interaction with objects
Verbalization
Physical contact with adults
Psysical contact with children

CHILD INTERACTION WITH OBJECTS

This is one of the behaviors that could occur during the 5 second interval you are observing a child.

Determine if the child was interacting with an object for any part of the 5 second interval.

An "object" is defined as everything <u>except</u>:

Walls, windows, floors, rugs, curtains and drapes (unless hung specifically for children's play);

Furniture (couches, chairs, tables, beds, lamps, stoves, refrigerators, etc.);

Pacifiers;

Food and eating utensils when child is in an eating situation;

Clothes the child or others are wearing (except dress-up clothes).

Some examples of objects are:

toys, pens and pencils, paper, books, ashtrays, piece of dust, flowers, dirt, sand, water hose, food and eating utensils in a play situation (such as a tea party or scooping sand), boxes, tunnel toys, clothing not being worn by anyone, pets, rocks, acorns, grass, brooms and mops, blocks, watches, jewelry.

CHILD INTERACTION WITH OBJECTS

- Interaction is defined as doing something with the object. For most objects, holding, touching, brushing against while walking, tripping over, stepping on, or looking at is not considered interaction. However, there are some objects for which looking is appropriate and a list of these is given later.

- Usually, interaction involves manipulating or fingering an object with the hands,~~(if a child is manipulating toy while it's in his mouth, this doesn't count)~~, or kicking or pedaling with the feet. The way the child is using an object need not be the way people ordinarily use it, or the way the manufacturer intended it to be used. For example, a child may be mouthing a book instead of reading it, and this would be considered interaction.

- Mark an X in the "Obj. In." box on the data sheet if the child interacted with an object. Leave the space blank if he did not.

* Always judge by what the child is doing, rather than what you think he wants to do. For example, if you thought a child was running to pick up a ball, but he didn't pick it up during the observation, do not mark an X on the data sheet.

* Try to get close enough to see what the child is doing before you begin the observation.

* If the child interacts with any observer materials (pencil, stopwatch, etc.) do not count this as interaction with objects.

CHILD INTERACTION WITH OBJECTS

Here are some examples of object interaction. This is not an exhaustive list of the millions of ways objects can be used. It should serve as a reference.

- Fingering a rattle;
- Watering a garden;
- Planting a seed;
- Running dirt through fingers;
- Petting a dog;
- Rolling a push toy;
- Picking up an object;
- Throwing an object;
- Paging through a book;
- Handing something to someone;
- Taking something from someone;
- Dropping an object;
- Waving a block in the air;
- Punching a balloon;
- Being behind drapes hung for play.

CHILD INTERACTION WITH OBJECTS

- Shaking a rattle;
- Pushing an object away;
- Pulling an object toward oneself;
- Ringing a bell;
- Banging a piano;
- Pounding on a drum;
- Building with blocks;
- Hitting a mobile;
- Riding a bicycle;
- Swinging on a swing (even if pushed, and too young to pump);
- Sliding down a slide;
- Pulling a wagon;
- Climbing onto a swing or slide;
- Being pulled in a wagon or box;
- Feeding a doll;
- Setting a table;
- Running fingers across a toy;
- Moving pieces in a board game;
- Rocking tunnel;
- Crawling through tunnel;
- Turning a ball;
- Banging object against wall or furniture;
- Pointing to pictures;
- Coloring;
- Taking wrapper off a crayon;
- Dressing a doll;

- Picking a flower;
- Handling dress-up clothing;
- Picking up a sock;
- Twirling a stick;
- Writing on blackboard;
- Moving child-sized furniture;
- Moving toys while looking thru toybox;
- Hanging up clothes;
- Rustling a plastic wrapper;
- Jumping a rope;
- Turning on TV, radio or phonograph;
- Blowing bubbles;
- Swiping at bubbles;
- Tumbling on tumbling mat;
- Jumping on trampoline;
- Splashing water;
- Ripping paper
- Kicking a ball or other object.

In some cases listed below, an interaction is scored if the child is merely looking at the object:

- Watching floating bubbles;
- Watching pets in tanks or bowls;
- Looking at a book or any printed material;
- Looking through a kaleidoscope or cardboard cylinder;

CHILD INTERACTION WITH OBJECTS

- Looking at mobiles (suspended toys);
- Watching TV, movies, cartoons;
- Looking in a mirror;
- Watching a puppet show.

CHILD VERBALIZATION

This is one of the behaviors that could occur during the 5 second interval you are observing a child.

Determine if the child verbalized in some way for any part of the 5 second interval.

Verbalization includes any sounds excluding crying, burping, coughing, sneezing, grunting, choking, vomiting, either addressed to another person, or unaddressed.

Babies may coo, laugh, or make babbling sounds. Older children may laugh, talk, sing, or make sounds.

Mark an X in the "Verb" box on the data sheet if the child verbalized. Leave the space blank if he did not.

Try to get near enough to the child before you begin the observation so you can hear if he speaks softly. Try to keep the child's face in view.

You do not have to understand what the child said to mark an X.

If a child talks to an observer, it is not counted as a verbalization.

CHILD PHYSICAL CONTACT WITH CHILDREN AND ADULTS

These are two of the behaviors that could occur during the 5 second interval you are observing a child.

Determine if the child was physically in contact with a child or an adult for any part of the 5 second interval.

The child is in physical contact with a child or adult if any part of the child's body touches any part of another child's or adult's body. Either child or the adult can initiate the contact, or the beginning of the contact could have occurred before your observation began. If the children or adult are being aggressive (hitting, biting, pinching, etc.) don't mark as physical contact.

Mark an X in the PCA box on the data sheet if the child was in physical contact with an adult. Leave the space blank if he was not.

Mark an X in the PCC box on the data sheet if the child was in physical contact with another child. Leave the space blank if he was not.

Try to get close enough to see what the child is doing before you begin the observation.

It is easy to see when an adult and child or two children are holding hands or tumbling over each other, but be alert for instances of bodies brushing against each other for an instant, or a child's hand leaning on another child's shoe.

If a child touches an observer, this does not count as PCA.

Here are some examples of child physical contact with adults. This is not an exhaustive list, just a reference you can use to judge what you see

- An adult is holding and feeding a child;
- An adult is touching a child's leg while changing his diaper;
- Rocking a child to sleep;
- A child crawls to an adult and lays a hand on her leg;
- A child hugs an adult;
- A child kisses an adult;
- An adult picks up a crying child;
- Patting a child on the head;
- An adult and child are sitting on a porch swing with their bodies touching;
- Adult and child are playing ring-around-the-rosie and holding hands;
- Adult places a child in the swing;
- Adult washes child's face;

- Tickling child;
- Removing a child physically from a dangerous situation.

Here are some examples of child physical contact with other children to use as a reference:

- Children are playfully tumbling over each other;
- One baby crawls on top of another;
- Two children are sitting on a slide with their legs touching;
- Two children are riding a bike and one is holding onto the other;
- A child's hand is touching another child's foot;
- Two babies are lying under a mobile and their hands touch.

If PCA and PCC occur in the same 5 second interval, mark an X in both boxes.

Here are some examples of PCA and PCC occurring simultaneousl

- An adult holding two children on her lap and the children are touching each other.
- A child holding an adult with one hand and a child with the other;
- A child hugging another child and an adult at the same time.